# THE EFFECTS OF STRESS ON NEUROPSYCHOLOGICAL TESTS OF ATTENTION AND MEMORY

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ABSTRACT

Title of dissertation: The effects of stress on neuropsychological tests of attention and memory

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Dissertation directed by: Andrew S. Baum, Ph.D., Professor, Department of Medical Psychology

This research examined whether the presence of a stressor affected performance on neuropsychological tests of attention and memory, and whether a distraction could ameliorate these potential effects. Distraction has previously been shown to reduce perceptions of tension and pain. It was hypothesized that acute stress would negatively affect performance, but that distraction would lessen these effects.

These hypotheses were explored by crossing the presence of a stressor (combat surgery film/nature film) with the presence of a distraction (written essay/no essay). Seventy-two subjects participated in one ninety minute session. Subjects blood pressure and heart rate were automatically monitored every three to five minutes throughout the session. Subjects filled out background information, mood, distraction, life events and perceived stress inventories, and a battery of neuropsychological tests before the film. Subjects then either remained quiet, or were administered the essay distraction manipulation for 15 minutes following the film. Subjects were then administered the final battery of neuropsychological tests, and mood and distraction questionnaires.

Results did not support the stress hypothesis, but because results of the stress manipulation were equivocal, definitive conclusions cannot be drawn. One neuropsychological test showed a significant difference, but in the opposite direction predicted: number of errors on the Trails B Test, an attention test, were slightly higher in the no stress-no distraction condition than in the stress-no distraction condition. The distraction hypothesis was not supported by this research, but because of the unclear results of the stress manipulation, further research is necessary. Perceived stress did not affect performance on the tests, and life events affected these tests in an unexpectedly positive fashion: more life events was associated with better performance.

Results of this study indicate that neuropsychological tests of memory and attention were not affected by stress, contrary to past research. Further research concerning distraction as a technique to ameliorate the effects of stress on neuropsychological test performance is necessary.

The Effects of Stress on Neuropsychological Tests of Attention and Memory

by

Sarah Nesselhof Kendall

Dissertation submitted to the Faculty of the Department of Medical Psychology Graduate Program of the Uniformed Services University of the Health Sciences in partial fulfillment of the requirements for the degree of Doctor of Philosophy 1993

## Dedication

To my parents, June Ross Nesselhof and Dr. John Nesselhof, my husband, Dr. Brian Kendall, and my son, Alexander Morrison Kendall, for the encouragement, support and love they have all given to me.

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Finally, as I wrote in the dedication, I owe so much to my parents. It was their love of knowledge, and their vision of what I could do and be that helped me achieve what I have. My husband, Brian, has been my rock, and without him, this

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# Introduction

## Overview

Since the 1940's, neuropsychological assessment has developed and grown into an area that combines traditional neurology with psychology to study a wide range of topics, including children's learning disabilities and behavioral problems, gerontological issues, and basic neuropathologies of the brain caused by infections, head injuries, neoplasms and degenerative disorders. Because neuropsychological techniques assess behavioral change, testing can be just as readily applied to research as to clinical diagnosis and treatment. Neuropsychological measures in research studies can be used to explore the organization of brain activity and how this activity is integrated with behavior. Because these standardized assessments are designed to be sensitive to subtle behavior changes while utilizing clinical normative values for comparison, neuropsychological tests can be used as non-invasive measures of brain activity and behavioral changes under various conditions.

One issue that has received little attention is the possibility that an acute stressor can cause changes in neuropsychological assessment outcomes. While it has been established that neuropsychological tests measure the effects of both central nervous system variables and exogenous, extraneous variables such as illness and injury to the brain

(Lezak, 1983), few studies have examined the effects of an acute stressor on neuropsychological performance as measured by these tests. Because such stressors have been shown to affect test and task performance, stress may also affect performance on neuropsychological tests. For example, people who are more test anxious may not perform as well on neuropsychological tests as people who are less anxious. Without considering this potential relationship between stress and neuropsychological tests, test results may be obtained which are not representative of the patient's real capabilities. Since recent research has hinted at a potential relationship between high levels of stress and diminished performance on tests of memory in HIV-positive military subjects (Nesselhof, 1989), the importance of assessing stress levels should become an integral and normal part of any neuropsychological evaluation.

This study examined the effects of an acute stressor on neuropsychological test performance, specifically on tests in the areas of attention and memory. It is doubtful that a stressor of this kind causes neurophysiological damage that is found upon testing and retesting. It is more likely that there are transient effects of acute stressors (perhaps caused by attentional reallocation) that can be picked up by neuropsychological testing at one time, but will not be picked up at another testing (assuming that the stressor is truly acute). This is readily applicable in neuropsychological testing, for if a potential subject or patient is dealing with

an acute stressor, then their performance may be affected at one testing but be normal at another.

If an acute stressor is found to affect neuropsychological test performance, then stress reduction techniques may adequately reduce levels of stress so that performance does not suffer. While there are many different techniques that can be used to reduce stress levels, one -- distraction -- was examined in this study. Distraction was not studied as a mechanism by which stress may affect performance, but rather as a means by which the negative effects of a stressor might be reduced to produce smaller performance deficits on neuropsychological tests. By reducing the negative effects of stress (or arousal), distraction may be one method that is successful in ameliorating the effects of acute stress on neuropsychological test performance.

This chapter reviews research on specific stressors -- noise, heat and examination stress -- that measured stressor effects on tests of cognitive skills similar to those used in neuropsychological assessments of memory and attention. Such extant work on stress and cognitive performance will be considered when deriving hypotheses concerning stress and neuropsychological assessment. Research which more directly concerns stress and neuropsychological assessment will then be explored. The field of neuropsychological assessment is large, and because not all areas of cognitive functioning have yet been shown to be affected by stress or anxiety, the areas of memory and attention were chosen for this study because of

the existing literature on stress effects on these cognitive functions. These studies were also examined in terms of their conceptualization of stress, as well as their approaches to methodology and their conclusions. Before reviewing these literatures, however, it is necessary to define stress and review its basic sequelae.

## Brief Review of Stress Research

In examining the relationship between stress and neuropsychological assessment, we must first ask, "what is stress"? Stress has been described as the mechanism through which environmental events endanger or test an organisms' safety and/or health; it is also the way in which the organism reacts to this risk (Baum, Singer, & Baum, 1981; Baum, 1990). Stress has been a widely studied topic in this century, and many different yet basic theories and approaches to the understanding of stress exist (see Cannon, 1927, 1935; Lazarus, 1966; Mason, 1975; Selye, 1955, 1956). In particular, Mason (1975) has described stress as a CNS-integrated response pattern. He states that psychological awareness -- whether conscious or unconscious -- of a harmful event is essential before stress can occur. This psychological threat may be requisite for adrenal secretion of epinephrine, norepinephrine and corticosteroids in stress responding.

It is widely accepted that the physical response to a stressor occurs via various components of sensory information which are sent to the brain, integrated, and turned into

messages received in the hypothalamus; the hypothalamus in turn initiates peripheral responses. Some stress responses are accomplished through the triggering of the hypothalamic-pituitary-adrenal cortex axis (HPAC), which results in corticosteroid release (Kidman, 1984). The sympatho-adrenal medullary axis (SAM) is also activated to release the catecholamines epinephrine and norepinephrine. However, it appears that if there is not some level of cognitive awareness of the stressor, this activation of the HPAC and the SAM does not occur; thus, hormonal stress responses are mediated by the brain (Kidman, 1984).

Research by Mason (1975) has indicated that emotional or psychological stressors are some of the most potent stressors, and that many laboratory stressors used in typical stress research evoke feelings of distress and emotional disturbance from the laboratory animals. Mason (1975) has found that when these psychological disruptions are greatly minimized, normally noxious physical stressors do not stimulate the HPAC. This lends support to the notion that psychological awareness of a stressor leads to the triggering of the hormonal stress response.

A particularly interesting area of the stress literature concerns the aftereffects of a stressor. Glass and Singer (1972a, b) used uncontrollable and unpredictable noise as a stressor to show that performance deficits (decreased tolerance for frustration, diminished performance on the Stroop Color Word Test and a proofreading task) appeared after

the stressor, and that the addition of either predictability and/or control alleviated these deficits. Spacapan and Cohen (1983) extended these findings by showing that simply the expectation of a stressor produced both effects (increased blood pressure) and aftereffects (decreased tolerance for frustration) during a period of anticipation of the stressor. This research, and earlier work by Baum and his colleagues (Baum & Greenberg, 1975; Baum & Koman, 1976) showed that anticipation of a stressor alone can produce stress effects without the stressor actually occurring. Explanations for anticipatory stress effects include the notion that people awaiting a stressor begin to experience it before it actually "begins", that people are unsure of what the stressor will be like, and that people think about the possible aversive aspects of the stressor, particularly if they are not certain of what to expect. There is evidence that rumination or thinking about a stressor can cause stress (Baum, 1990; Tesser, Millar, & Moore, 1988).

It is clear that there is a psychological component of stress responding and that this psychological awareness can produce performance deficits even without the actual stressor occurring. It is plausible, then, that the anticipation of a longer stressor could affect performance on neuropsychological tests both after an acute stressor as well as before this longer stressor occurs. In the study described in the next chapter, all subjects will be given neuropsychological tests before an acute stressor as well as while they are

anticipating a longer stressor.

Stress and Performance

Several areas of the more general stress and performance literature will be addressed in order to build a solid framework for the examination of research concerning the effects of a stressor on neuropsychological test performance. Models of stress and performance that have received support will be introduced, and research that examines the effects of noise stress, heat stress, and test anxiety on performance will be surveyed.

Models. There are four basic models which have been used to explain the relationship between stress and performance: the arousal models of Yerkes and Dodson (1908) and Easterbrook (1959), the information overload model, and an alternative model posited by Cohen, Evans, Stokols, & Krantz (1986). These models will be examined separately, and studies which support them will be briefly discussed in order to better identify and understand the relevant issues in the general area of stress and performance.

The arousal model of human performance was first set forth in the Yerkes-Dodson model (Yerkes & Dodson, 1908). It posits that there is an inverted U-shaped function between task performance and arousal. In other words, extremely high or extremely low amounts of arousal will cause performance deficits (Kahneman, 1973). Arousal is conceptualized as both physiological and behavioral: physiologically, arousal is a

nonspecific change in the reticular formation of the brain, while in terms of behavior, arousal is viewed as a continuum which ranges from high levels of excitement to deep sleep. In this model of stress and performance, overarousal or underarousal cause performance deficits when compared with the effects of optimum levels of arousal on performance.

Easterbrook's (1959) theory of arousal suggested that high levels of arousal decrease or narrow the focus of attention, causing only the most central or important cues of a task be noted. This narrowing-of-attention hypothesis has been used to explain why, for a complex task, an individual is more likely to disregard (or not perceive) cues which are relevant to task completion. For simple tasks, there are fewer cues which are integral to task completion. However, Broadbent (1971) has argued that the effects of attentional narrowing are decisional and do not deal with the perception of cues. Therefore under conditions of overarousal, subjects pay more attention to important cues. Hockey (1970) has demonstrated this by showing that more errors occur during a noise stressor in the part of a task that the subjects have been told is not important, as compared to fewer errors during the part of the task that the subjects believed was important.

Another model that deals with the relationship between stress and performance is the information overload model. This model suggests that there is a limited capacity for information processing, and that information overload may occur any time the demand for attention is greater than the

total available information-processing capacity (Cohen et al., 1986). Milgram (1970) also used the overload model to describe crowding as an excess of social and physical inputs that negatively affect cognitive functioning (see Milgram, 1970, p. 1462 for full description of model). Cohen (1978) has further posited that cognitive capacity is reduced by stressors because these stressors themselves require attention. Thus, as more attentional capacity is allotted to the stressor, there is less capacity for other task demands, such as completing the task.

This model acknowledges the cognitive appraisal of a stressor as important to the amount of attentional capacity used. External stressors, then, may create informational overload because they require attention, decreasing the amount of attention left for dealing with tasks. Thus, there is thought to be a refocusing of attention toward the aspects of the stressor which are most important, and a diminished amount of attention focused on the aspects of the task which are less relevant. This model is similar to the narrowing-of-attention model in that only the most salient cues are noted. However, in the information overload model, attention is completely allotted to the stressor itself, and consequently other aspects of the task -- namely task completion -- can suffer.

Finally, a model put forth by Cohen et al. (1986) states that stressors cause individuals to change their cognitive strategies by a re-allocation of attention to more important aspects of the task at hand, quicker information processing

through working memory, and improved spatial memory for sequential information. This model, then, does not automatically predict performance decrements under external stressors; rather, a stressor will affect cognitive processing if attention must be redirected -- only then will performance on the task be affected.

Having examined these models of stress and cognitive performance, the specific stressors of noise, heat and examination stress will be evaluated in order to briefly delineate what cognitive effects have been found.

Noise Stressors. Noise is one of the most heavily researched stressors in the stress and performance literature. Glass and Singer have provided solid research on noise and its effects on performance: Glass, Singer and Friedman (1969) studied the aftereffects of predictable and unpredictable noise on a tolerance for frustration test and a proofreading task, in part a measure of attention to errors. Results showed that after loud noise was stopped, tolerance for frustration and proofreading were affected more by the unpredictability of the noise than by its volume. Further work by Glass et al. (1969) found that the perception of control decreased negative aftereffects of exposure to unpredictable noise. The results of these studies indicate that exposure to noise which cannot be predicted or controlled is associated with performance deficits after the noise has stopped. Glass and Singer (1972a,b) hypothesized that such unpredictable and uncontrollable events may cause stress

because an individual believes that they cannot control the stressor and that this produces feelings of helplessness. With regard to attention, it would appear that the unpredictable nature of the stressor in this study had negative effects on the proofreading task, a measure of attention. In trying to relate these findings to neuropsychological testing, it may be that there are unpredictable and/or uncontrollable aspects of a stressor which might affect performance on these tests. To date, no research has yet examined the effects of unpredictable and uncontrollable stress on neuropsychological tests.

Hockey and Hamilton (1970) looked at the effects of a noise stressor on performance during exposure to the noise. They presented eight-word sequences on slides, and then measured immediate recall for these sequences. When noise was introduced during the learning phase, accuracy of recall was slightly increased. The subjects were next asked to remember where the word sequence had appeared -- a measure of incidental memory. Those subjects in the noise condition remembered significantly less than subjects in the no-noise condition. The informational overload theory also may account for this, as only the most salient cues (the word sequences themselves) are attended to, while the less important cues are ignored. The narrowing-of-attention model could also account for this finding, as the words themselves are remembered, but not the less important sequence in which they occurred. In terms of neuropsychological performance, it is possible that

some neuropsychological functioning may be improved under conditions of stress, while others may be diminished, however the literature has not yet addressed this issue.

The models of stress and performance discussed earlier can be applied to these studies on noise stressors. While the Glass, Singer and Friedman (1969) work examined aftereffects of stress, it is possible that the subjects were still (minimally) aroused from the noise stressor and this interfered with performance (as in the arousal model), or perhaps their attention was still focused on the noise and there was not enough informational capacity left to perform adequately (as in the informational overload model). Hockey and Hamilton's (1970) findings naturally lend themselves to the position of the informational overload model -- which states that only the most salient cues are attended to under conditions of stress. It can be seen from this discussion of noise stress studies that no <u>one</u> theory of stress and performance is correct. It appears, then, that these theories are all partially applicable and that work which integrates them is necessary.

<u>Heat Stressors</u>. A great deal of work has also examined heat stressors and performance. Only a representative sample of the work in this area will be discussed (see Grether, 1973 for a comprehensive review). Poulton (1976) advocated the behavioral arousal (or inverted U) theory, and proposed different effects on performance based on different arousal states. Specifically, he suggested that mild ambient heat

which leads to discomfort increases performance because of a commensurate increase in the level of arousal. If an individual remains in this heated environment, then body temperature increases gradually, and arousal and vigilance are decreased. If the ambient temperature rises very suddenly, then arousal and attention would again increase. However, as the thermal ambient temperature rises to conditions which are intolerable, attention will quickly decrease.

Hancock (1986) asserted that Poulton's explanation of attention and thermal stress is only a post-hoc explanation and cannot be used to predict which temperatures will increase arousal and attention and which will not. Hancock (1986), in his review of the effects of thermal stressors on vigilance (sustained attention), believes that performance worsens as the normal body temperature of an individual is disturbed. In his attentional resource capacity model, Hancock contends that when temperatures are extreme enough to change the normal homeostatic condition, sustained attention is impaired. He also maintains that if deep or core body temperature stays unchanged, then attention and performance will remain the same.

Two studies have shown inverted U-shaped functions that support the arousal model of stress and performance. Wilkinson, Fox, Goldsmith, Hampton, and Lewis (1963) studied the effects of heat stress on sustained vigilance, using an auditory vigilance test and a simple adding test. Results indicated that at low heat levels, there were small changes in

a positive direction showing an improvement for the adding task, but there was also an impairment in vigilance. However, when scores from the hottest condition were compared with scores from normal temperatures, adding ability was impaired but vigilance was improved. Finally, although subjects became heat acclimatized, there was no corresponding improvement over time in their performance tests with elevated temperatures. The authors viewed this finding as support for the hypothesis that for these tests of vigilance and addition, the central nervous system did not show any short-term adaptation to such repeated increases in body temperature.

The arousal theory was supported here, but with a new twist: different functions (or curves) for different tests. This may be a good warning to researchers in the field of cognitive performance and stress: a finding for a specific cognitive function may not hold true for all cognitive functions. A study by Epstein, Keren, Moisseiev, Gasko and Yachin (1980) examined the effect of different heat loads and task intensities on psychomotor performance. Results of the performance measures showed that a moderate heat load led to increased performance speed on a video game when compared with the performance at the severe and comfortable heat loads. This is a clear demonstration of an inverted U-shaped function for heat load and performance, in that a moderate heat load showed better performance results than either comfortable or severe temperatures. The authors concluded that "even highly motivated subjects" (Epstein et al., 1980, p. 610) are

affected by high levels of thermal stress, especially under conditions which require sustained attention.

Several studies have demonstrated that extreme temperatures adversely affect cognitive performance in a linear fashion. Studies by Curley and Hawkins (1983) and Gopinathan, Pichan, and Sharma (1988) examined the effects of heat stress on new learning behaviors and short term memory, using serial addition and the Trail Making tasks. Both studies found a decrease in performance under conditions of high temperatures.

Unlike the results of the noise studies reviewed in the previous section, the results of the thermal stressor studies seem to indicate that extremely high temperatures cause performance deficits on neuropsychological as well as basic cognitive tests. In terms of the neuropsychological functions which are affected by noise and heat stressors, it is again the areas of attention (as measured by tests of sustained vigilance and proofreading) and memory (for words and digits) that are affected most by these stressors. It appears that these stressors do not work in similar ways -- some cognitive functions affect performance in an inverted-U shaped pattern, where extreme levels of the stressor cause worsened performance, and some functions work linearly, where increasing levels of the stressor produce increasingly worsened performance.

Test Anxiety. Levitt (1980) has likened anxiety to fear, defining it as a "subjective feeling of apprehension and

heightened physiological reactivity" (p. 5), and Sarason (1980) has stated that anxiety is a response to perceived danger, as well as the inability to take care of such danger or challenge in a beneficial way. Sarason (1975) considers anxiety to be a kind of self-preoccupation which is typified by self-doubt, belittling of the self, and extreme self-awareness. Spielberger (1966) has done extensive work on the splitting of anxiety into "moods" or "characteristics": the concepts of state anxiety (or a temporary mood) and trait anxiety (a non-transient characteristic) gained much popularity with his research (see also Cattell and Scheier, 1960). For this study, the terms "stress" and "anxiety" will be considered as basically similar constructs.

Sieber (1980) views test anxiety as a group of responses to certain stimuli that are associated with an individual's testing (or evaluation) background. In ground-breaking work by Mandler and Sarason (1952), it was maintained that individuals who are highly anxious attend more to events that are not pertinent to their test or task at hand than do individuals who are low in anxiety. It is typically thought that there are two components of test anxiety: autonomic responding (eg., increased heart rate and blood pressure, sweating) and cognitive events (eg., unwanted negativistic thoughts, or worrying) (Sarason, 1980). These self-preoccupying cognitive events are thought to interfere with cognitive processing in the highly anxious individual. A brief review of the test anxiety literature reveals some relationship between test

anxiety and cognitive performance.

Many researchers have studied the effects of test anxiety on real-life examination performance (Deffenbacher, 1986; Liebert & Morris, 1967; Paul & Eriksen, 1964), as well as on specific tests of cognitive functioning (Mueller & Overcast, 1976; Ray, 1979; Schmolling, 1978). Schmolling (1978) used three groups of college students to determine whether the loosening of verbal associations between words was a common reaction to stress. The stress/normal group was examined under exam conditions, and then under regular classroom conditions, while the normal/stress group was examined in the reverse order. The normal/normal group was studied under two regular classroom conditions. The performance measure was a word association task: words were presented on a page with a blank space for the subject to write the first word that they associated with the target word. The stress/normal group had higher commonality scores (the number of instances that the subject gave the dominant or most often associated word) during the normal condition than during the stress condition, demonstrating that stress reduced the probability of the subject emitting the dominant word. The normal/stress group and the normal/normal group showed no differences between the two trials for the word association task. The results of this study indicated that test anxiety broke down the bond between verbal word pairs.

Schmolling (1978) hypothesized that stress increased the amount of responses from all sources that compete for

attention, thus decreasing the number of stimuli that can be attended to and decreasing performance. Many neuropsychological tests depend on the ability to attend to the task at hand as well as word associations. It is plausible that stress could decrease performance on various neuropsychological tests by decreasing the number of stimuli to which an individual can attend.

Other studies have shown that test anxiety causes performance deficits on cognitive tests (Mueller & Overcast, 1976; Ray, 1979). Ray (1979) used the Stroop (1935) color-word task to study the effects of stressful and neutral words on response time -- also known as the interference effect. The Stroop test measures the individual's ability to separate word and color stimuli and react to each separately (Sweetland & Keyser, 1986). This experiment tested the hypothesis that the potential of stressful words to interfere or distract would be different for different people. The stressful examination-related words caused more delay in responding than did the neutral words. This effect was larger for those subjects who were more anxious than for subjects who were less anxious. Performance was shown to be affected by stressful words, dependent upon the source of the arousal, and also dependent upon the relationship between the arousal and the type of stimulus presented.

Finally, Mueller and Overcast (1976) examined the effects of test anxiety on free recall, a verbal memory function. The subjects were 144 male and female undergraduates who were

selected because of their extreme (high or low) test anxiety scores. While level of anxiety had no effect on a measure of word recall, those subjects who were highly anxious performed more poorly on the digit span than did subjects who were not anxious.

From these studies of test anxiety, it is evident that individuals who suffer from test anxiety also suffer from commensurate performance decrements, most especially in the areas of cognitive functioning that deal with verbal memory and perhaps attention. The research reviewed in this section has shown that external stressors such as noise, heat, and test anxiety can affect performance on cognitive tests of attention and memory in a negative manner. That is, when these stressors are present, performance on such tests suffers. The final sections of this chapter examine memory and attention with respect to neuropsychological functioning, and then delve into the existing literature on neuropsychological assessment and stress.

## Neuropsychological Assessment and Stress

Because neuropsychological assessment is a standardized, non-invasive method that can be used to explore how brain activity is interpreted into behavior, it can easily be adapted for use in research. Such assessment seems a logical choice for the examination of how stress may affect neuropsychological performance, because the invasion of different external stressors may transiently affect an

individual's performance on tests that measure neuropsychological functions. It is how these external stressors temporarily change performance that needs to be studied. Memory and attention will be described next, as they are two areas of cognitive functioning which appear to be most affected by stress.

## Neuropsychological Assessment of Memory and Attention

Memory. Memory is defined by Lezak (1983) as the way an organism records a previous exposure to an event or experience, and by Shepherd (1988) as the ability to "store and recall information" (p. 604). According to Kolb and Whishaw (1985), the process of memory leads to a relatively permanent change in behavior, yet can only be inferred, not observed directly.

There are at least three main stages of memory, as outlined by Mesulam (1985) and Shepherd (1988). The first stage is that of acquisition, also known as the memorizing process, during which information is placed into circuits in such regions as the hippocampus, and memory traces are built. The second stage is that of storage, during which the information is retained in those circuits and memory traces are retained within them. The third and final stage is that of recall or the remembering process, during which the information is brought back via the memory traces to construct a motor or perceptual product. Also, there are two basic kinds of memory: short-term memory is immediate memory (stored within hours to weeks) for specific sensory events

that may or may not yet be consolidated into long-term memory (stored from early childhood), which is more stable and long-lasting (Hecaen & Albert, 1978; Lezak, 1983).

Three basic tests will be discussed in terms of memory deficit assessment. These tasks are the most often used tests of memory in the neuropsychological literature. The first is the Digits Backward subtest of the Digit Span test from the WAIS. The Digit Span subtests are part of the "verbal" section of the Weschler Adult Intelligence Scale (WAIS; Weschler, 1955) and the Weschler Adult Intelligence Scale - Revised (WAIS-R; Weschler, 1981). The subtests are composed of seven pairs of random number sequences which are read aloud by the Experimenter; the subject is asked to repeat these sequences in the exact order that the numbers were read for the forward part of the test, and in the reverse order of what was read for the backward test. This subtest requires that the subject store several bits of data while simultaneously re-ordering them. The Digits Backward test is an effective test of working memory, and explores the mental double-tracking (concurrent memory and the ability to reverse procedures) aspects of the test (Lezak, 1983). This test has been shown to be sensitive towards left hemisphere damage as well as defects of the left visual field. These findings suggest that the Digit Span backwards test is sensitive to functions in the brain which are related to verbal processing, including the functions of reading, writing, speaking, verbal thoughts and memory, and dealing with the numerical symbol system.

The Auditory Verbal Learning Test (Rey, 1964) is a verbal recall test which evaluates, among many other things, immediate memory span and retention capabilities. This word list learning test consists of five presentations with immediate recall of a list of 15 words, and then a test of retention at least 30 minutes later (Lezak, 1983). The score for this test is the number of correctly remembered words. This test also measures left hemisphere involvement, as word recall and verbal memory are predominantly controlled by the left hemisphere in most people.

Finally, the Formboard Test (also known as the Tactual Performance test of the Halstead-Reitan Neuropsychological Test Battery; Reitan, 1969) is a test of tactile memory. Subjects are blindfolded and then asked to place differently shaped blocks into a board which has similarly shaped holes. The subject is asked to complete this task with each hand and then with both hands, and also to recall the board after completing the task and draw it from memory. While the other two representative tests of memory were easily identified as sensitive to left hemispheric functioning, this particular test has not had such clear-cut results. Both the right hemisphere (Reitan, 1964) and the left hemisphere (DeRenzi, 1968) have been implicated in performance deficits on this test. It is also unclear which area of the brain the test is tapping. Both the frontal lobe and the posterior regions have been connected with poor performance on this test. Future research will hopefully be able to show more definitively

which area of the brain is assessed with this test.

From these three tests of memory, it is apparent that various processes of verbal functioning mediated by the left hemisphere are being evaluated. In the next section, attention is discussed as another cognitive function that may be affected by stress. After this discussion, the current literature concerning stress and neuropsychological test performance is evaluated.

Attention. Attention is not directly assessed in studies which report significant findings between stress and neuropsychological test performance. However, the Digit Span is often the test which prompts these findings, and this test is a strong measure of attention (Lezak, 1983; Mesulam, 1985). Because of these indirect findings, attention will be examined as another possible cognitive function with which stress may interfere.

Kahneman (1973) described attention as being both intensive -- needing undivided effort -- and selective -- being able to partial this effort to various mental activities and not to others. There are two major classes of models of attention, the first of which are the structural models of attention. These models examine cognitive activity in terms of bottlenecks, or places where parallel processing becomes jammed. Broadbent (1957) has placed this bottleneck at the stage of perceptual analyses of the stimulus. He believes that human perception is limited in capacity, and that to compensate, sensory channels select input information based on

their characteristics and also on what is already permanently stored. In general, then, only one stimulus may be perceived at any given time, and perception is regulated by attention. In the structural model proposed by Deutsch and Deutsch (1963), all stimuli are perceived, but only one response may be given at a time. Here, then, responding is governed by attention. In contrast, capacity models of attention specify that one's limited capacity to carry out cognitive work is partialled among ongoing activities (Moray, 1967). In this conceptualization of attention, easy tasks need little effort, while difficult tasks require more effort. It appears that both of these models are accurate, and operate together to make up attention (Kahneman, 1973).

Lezak (1983) loosely defines attention as the ability to selectively perceive, while Cohen et al. (1986) add that attention is an ability to selectively perceive information from the environment. Deficits in attention emerge as an inability to focus on any form of directed behavior (extreme distractibility) without regard to the individual's willingness to perform adequately. It is believed that the limbic system is involved in controlling attentional focus, thereby regulating what is screened into and out of the perceptual field and subsequent registration of stimuli (Lezak, 1983). The limbic system is located mainly in the temporal lobe, but spreads to the midbrain and also to the forebrain area (Lezak, 1983). It is thought to play a part in emotional experience and expression, memory functions,

motivation, and visceral motor functions (Carlson, 1981; Lezak, 1983; Shepherd, 1988; Walsh, 1978).

Some neuropsychological tests are more sensitive to measuring attention deficits than are others. Several of the basic tests that are most responsive to attentional problems will be examined. The first of these is the forward Digit Span from the WAIS. The Digits Forward test is more a test of "the efficiency of attention" (Lezak, 1983, p. 268) than of memory. It is also strongly affected by anxiety (Mueller & Overcast, 1976), with high levels of anxiety decreasing the number of digits correctly remembered (Stone, Gray, Dean, and Wheeler, 1988).

Another test used to measure attention is the Trail Making Test, which originates from the Halstead-Reitan Neuropsychological Test Battery. This test was originally developed for the Army Individual Test Battery (1944) as a test of both visuomotor tracking and visual conceptual tracking; however it is also used to test attention and motor speed (Heaton & Pendleton, 1981; Lezak, 1983). In part A of the test, the subject is asked to draw lines to connect encircled numbers in sequential order. In part B of this test, the principle remains the same, but the subject must draw lines from a circled number to a circled letter consecutively. The time needed to finish and the number of errors are the scores for each test. This test has successfully measured visual scanning and tracking problems, as well as the flexibility of the individual to shift sets

within an ongoing activity, and the test has proven useful in measuring individual difficulties and disabilities.

Finally, the general category of cancellation tests assesses sustained attention, as well as fast visual selectivity, response inhibition, and visual scanning and activation (Lezak, 1983). In general, there are randomly spaced numbers (or letters) on a page, and the subject is asked to cross out a designated target number (or letter) as quickly as possible. The score is usually the number of errors and the time taken to complete the test. This type of test is associated with spatial neglect (Lezak, 1983; Mesulam, 1985); it is also a good indicator of generalized response slowing and inattentiveness (Lezak, 1983).

The neuropsychological tests of attention described above have been shown to measure functions such as verbal memory and recall, attention, and response slowing -- the very areas that may be affected by stress.

Neuropsychological Assessment and Stress. In terms of actual neuropsychological tests, only a handful of studies have been carried out that measure the effects of various stressors on performance on these tests. In fact, most of these studies examined anxiety instead of stress. However, it is widely assumed that stress affects neuropsychological test performance: "all an examiner need do is...make him (the patient) anxious...and his test scores will plummet" (Lezak, 1983, p. 120). In clinical practice, psychiatrists, psychologists, neurologists and neuropsychologists all attempt

to test the patient when the patient is the least stressed, in order to get the best possible performance. Indeed, general effects of elevated anxiety levels such as scrambling or blocking on words, mental slowing, and memory lapses have been reported (King, Hannay, Masek, & Burns, 1978; Mueller, 1980; Wrightsman, 1962). Specifically, three neuropsychological tests are affected by stress or anxiety: the digit span test (Diethelm & Jones, 1947; Mueller, 1980; Mueller & Overcast, 1976; Pyke & Agnew, 1963), and the finger tapping and formboard tests (King et al., 1978) from the Halstead-Reitan Neuropsychological Test Battery (Reitan, 1969). These tests reveal that verbal and tactile memory as well as manual dexterity are affected by stress or anxiety.

The digit span test probes verbal memory functions by examining the immediate recall for an amount (or a span) of stimulus information which has been placed into short term storage. Mueller (1980) and Mueller and Overcast (1976) examined test anxiety in relation to neuropsychological performance, and found that highly anxious subjects had smaller digit spans than non-anxious subjects, and that the items recalled by the highly anxious subjects were the last items they heard. In other words, highly anxious subjects used a memory strategy for which they were not well-equipped, and this strategy was not beneficial. This strategy is basically one in which anxious subjects remember only the most recently prompted items -- apparently a recency effect for short-term memory retrieval.

In an early study of female psychiatric inpatients (Diethelm & Jones, 1947), it was found that high levels of anxiety decreased performance on the Digit Span test, indicating a decrease in attention and revealing that learning is slowed by anxiety. Diethelm and Jones (1947) suggested that anxiety negatively affects active attention, learning, concentration, memory and retention. They also explicitly stated that in a psychiatric interview setting, levels of anxiety should be assessed in order to account for any possible effects of anxiety on the patient's thinking. Finally, another study (Pyke & Agnew, 1963) used the Digit Span test to show that shock decreased Digit Span performance only when the task was novel. When the shock was introduced after the Digit Span was practiced, no effect of anxiety was found, indicating that anxiety may impair performance on complex or unpracticed tasks, but not tasks which are simple or not familiar.

Two studies that examined anxiety, gender and cognitive test performance have been conducted. King, Hannay, Masek, and Burns (1978) studied male and female subjects' performance on the Finger Tapping Test (a test of motor speed and manual dexterity) and the Form Board Test (a test of spatial memory and manual dexterity or manipulative agility). Subjects were also given the State-Trait Anxiety Test (Spielberger, Gorusch, & Lushene, 1970) to measure levels of transient and long-standing anxiety. For women, trait anxiety was negatively correlated with the Finger Tapping Test, but positively

correlated with the Form Board Test. That is, those women who were anxious performed fewer finger taps and took longer to complete the formboard than did women who were not anxious. Some cognitive tests, and in turn, some cognitive functions, are clearly affected by anxiety, while others appear to be unaffected. Further, these researchers only found an effect for women. However, a study by Chavez, Trautt, Brandon, and Steyaert (1983) again explored the relationship between anxiety, sex, and neuropsychological test performance in undergraduates. The results of this study revealed that males scored significantly better on the Finger Tapping Test, but that anxiety did not affect any of the findings on the cognitive tests.

While various constructs of anxiety were measured in the previous research, all were laboratory studies of neuropsychological test performance. However, studies by Kral, Pazder, and Wigdor (1967) and Klonoff, McDougall, Clark, Kramer, and Horgan (1976) probed more enduring aspects of stress by exploring the neuropsychological test performance of World War II veterans. Kral et al. (1967) explored the long-term effects of severe, extended stress on World War II prisoners of war (POWs') held in Hong Kong. Compared with a control group of their male siblings (not matched for age) who also served in the war, POWs' reported higher levels of anxiety, depression, and tension, and performed more poorly on standardized tests such as the WAIS (Weschler, 1955) verbal and performance scores, and the Finger Tapping Test. However,

there were no premorbid intelligence scores for either groups of men, and accurate assessments of changes in intelligence over time cannot be made. The authors concluded that these POWs' have suffered an "impairment in nervous functioning" (p. 180), but it is impossible to evaluate which of the many stressors these people endured are responsible for their altered functioning.

In an extension of this study, Klonoff et al. (1976) studied World War II POWs' from two different sites of internment: Japan (the high stress group) and Europe (the low stress group; although this appears to be a relative term, for any POW is under substantial threat). These ex-soldiers were examined for neuropsychological, psychiatric, and physical/neurological symptoms. Findings indicated that there were significant differences for each of these areas, the most important of which were the neuropsychological findings. The examination included the WAIS, the Category Test (a test of abstraction ability), the Trail Making Test, Finger Tapping, and several other indices from the Halstead-Reitan Battery. The high stress group performed significantly worse on the Trail Making Test, and the Category and Seashore Rhythm Tests from the Halstead-Reitan battery. There appeared to be an interaction between the neuropsychological test results and the length of internment, such that the longer the internment, the worse the performance. Again, it is difficult to specify exactly which of the horrors the soldiers experienced could account for these deficits, and nutrition was not taken into

account, but it does appear from this study and from the Kral et al. (1967) work that a severe and prolonged stressor such as internment as a prisoner of war could have significant effects on neuropsychological tests which measure abstraction ability, attention and manual dexterity.

Taken together, these studies indicate that high anxiety levels lead to decreased memory span, indicating weakened verbal memory and recall, as well as a decreased attention span. While these findings could be potentially useful to researchers and clinicians using neuropsychological tests, the neuropsychological literature has never extended this research. However, two issues need to be highlighted. Most of these studies used anxiety rather than a stress manipulation, and most did not control subject variables. In terms of the stress measure, two of the studies (Mueller, 1980; Mueller & Overcast, 1976) used only the test anxiety construct as their index of stress, while Diethelm and Jones (1947) used high levels of "psychiatric anxiety" as stress. In studies with similar findings of negative effects of stress on test performance, King et al. (1978) and Chavez et al. (1983) used the State-Trait Anxiety distinction as their operationalization of stress. Only one study used a laboratory stressor (shock; Pyke & Agnew, 1963) to find mixed results of the effects of stress on neuropsychological tests. Further, the research on WWII POWs' by Kral et al. (1967) and Klonoff et al. (1976) is heavily confounded, or open to alternative explanations, including high stress levels in both

the control and experimental groups, no examination of nutritional state, and the stress of the combat experience operating simultaneously with the stress of the POW experience. It seems very clear that further work in this area that incorporates laboratory stressors with neuropsychological testing is necessary before any firm judgement about the effects of stress on such testing can be made.

Stress has been shown to affect attention, verbal memory functions (in particular verbal and tactile memory), and manual dexterity. However, the literature reviewed in this chapter that addressed stress and neuropsychological assessment are not adequate to firmly state that there is a direct negative relationship between stress and such test performance. What is sorely needed in the area of stress and neuropsychological assessment is research which uses a proven laboratory stressor on subjects who are randomly assigned to clearly defined stress and control groups.

If stress is found to affect performance on neuropsychological tests of attention and memory, a second question that needs to be examined is whether or not this stress can be overcome to mitigate incidental changes in performance on neuropsychological tests. There are many ways to reduce stress, including relaxation techniques, cognitive restructuring, and biofeedback. The study described in the following chapter examined another possible means of reducing stress -- distraction -- which will be used during the

anticipatory stress period. This distraction is hypothesized to decrease the amount of time the subjects spend thinking about the stressor, in turn reducing stress levels and reducing performance deficits on the neuropsychological tests.

Distraction

During the anticipation of a stressful event, the individual is faced with many questions, especially those that are concerned with how to manage or cope with the stressor. Some of the ways that people cope with an impending stressor include psychological distancing, denial of the ramifications of the stressor, and avoiding thoughts of the stressor altogether (Lazarus & Folkman, 1984). Lazarus and Launier (1978) also describe methods similar to these in their intrapsychic coping modes. These modes of coping include any kind of cognitive process which alleviates stress by making the individual feel better. These authors describe various forms of intrapsychic coping that reduce stress, and/or avoid the stressor altogether. Distraction can be viewed as a form of dealing with a stressor, as it can distance the individual away from the stressor by focusing their attention on something other than the stressor. This process is thought to decrease the stress that the individual is feeling. Distraction, then, has been defined as a shifting of "one's attention away from the sensations or emotional reactions produced by a noxious stimulus" (McCaul & Malott, 1984, p. 517).

Distraction per se has been little studied in terms of reducing the negative effects of stress on mood or affect. Singer (1974) has suggested that a message that is not relevant to a stressor may be able to serve as a distraction, and that by attending to this message, a stressed person may avoid stressful thoughts and expectancies. Those studies that exist do not often look at distraction by itself, but in conjunction with another treatment condition. For example, Abrahamson, Barlow, and Abrahamson (1989) and Adams, Haynes, and Brayer (1985) both studied distraction and other treatments in relation to sexual dysfunction in men and women. Both studies showed that cognitive distraction often decreases sexual arousal. Allen, Danforth, and Drabman (1989) used a videotaped coping model film along with a film distraction technique in hopes of reducing the stress involved with hyperbaric oxygen therapy. Their results indicated that experimental subjects were much less aroused and felt more relaxed before treatment than were controls. However, because there were only two groups (coping video/film distraction and control), it is unclear what part(s) of the manipulation contributed to the effect. Finally, Fillingham, Roth & Haley (1989) found no effect of distraction on either mood or exercise-induced symptoms in college students. These researchers hypothesized that distraction worked via the "competition of cues" hypothesis, which states that distraction would decrease the perception of such symptoms by occupying one's restricted attentional capacity. This study

indicated that attentional demand does not determine the efficiency of distraction.

Work has also been done in the area of pain control and distraction. Spanos, McNeil, Gwynn, and Stam (1984) showed that individuals low in hypnotic susceptibility who were distracted had as much of a reduction in pain ratings as highly susceptible individuals who were given analgesic imagery suggestion. They concluded that reductions in rated pain may be due more to diversion of attention, and other cognitive activities. On the other hand, Farthing, Venturino, and Brown (1984) found that among high hypnotizable subjects, analgesic suggestion, distraction, and suggestion and distraction all reduced rated pain reports, and that suggestion and distraction alone worked just as well as together. For low hypnotizables only distraction was effective. Marino, Gwynn, and Spanos (1989) also found that distraction could lower the ratings of perceived pain.

In other studies examining the effects of distraction on pain, Wostratzky, Braun and Roth (1988) found that auditory distraction during dental procedures reduced the amount of pain reported afterwards, and helped the patients cope with the stress of these procedures. Broome, Lillis, McGahee and Bates (1992) also found that a combination of distraction and relaxation techniques decreased pain reports over time in children undergoing repeated lumbar punctures. In a study conducted on experimental subjects and not clinical patients, Hodes, Howland, Lightfoot and Cleeland (1990) examined the

effects of an affectively neutral distraction on responses to cold pressor pain. They found that subjects who received the distraction treatment reported reduced pain ratings, but no lengthening of the actual tolerance time (time arm left in cold water).

Distraction has also been studied with respect to the controlling of aversive reactions (often conditioned nausea/vomiting) to chemotherapy. Redd and Andrykowski (1982) suggested that many techniques which successfully treat or control these conditions work, in part, because of the distraction factor inherent in each. For example, listening to a relaxation tape or watching the screen of a biofeedback monitor all share a distraction factor, such that nausea and/or vomiting is reduced, in part, by the simple act of switching attention from the stimuli which can produce these symptoms to these other stimuli. In fact, several studies have shown reduced reports of nausea and vomiting using video games as the distraction in patients undergoing chemotherapy (Greene, Seime & Smith, 1991; Kolko & Rickard-Figueroa, 1985; Redd, Jacobsen, Die-Trill, Dermatis, McEvoy & Holland, 1987).

This body of research suggests that distraction is a cognitive process that might divert attention away from a stressor and may decrease distress in certain instances. However, to date, distraction has not been studied as a means of reducing stress in order to decrease its potentially negative effects on neuropsychological test performance.

Distraction was chosen as a means of reducing stress

because it may be one of the more useful techniques available. Highly-stressed individuals could be so aroused that their performance is poor and not representative of their performance under optimal arousal conditions. Subjects who are under-aroused (as could be those individuals participating in relaxation techniques) might also not be able to perform to the best of their abilities. While it is also possible that relaxation could decrease arousal to approximate optimal performance levels, this study examined the former prediction -- that distraction will lower arousal levels enough for subjects to perform at their best level. It was hypothesized that the distraction used in this study to decrease the time spent thinking about the stressor would reduce subjects' levels of stress and arousal enough to allow optimal or normal performance, but not so much as to produce performance deficits because of underarousal. Future research should examine how relaxation techniques might be used to lower the subjects' arousal level to their optimum arousal level but not beyond.

The research proposed in the next chapter examined the effects of a combat surgery film stressor on neuropsychological test performance in hopes of finding out whether there is indeed a relationship between such an acute stressor and test performance, and whether or not the negative effects of stress can be reduced by a distraction to reduce performance deficits on these tests.

Summary

After this brief exploration of stress and neuropsychological assessment and related literatures, it should be clear to the reader that there may be a negative relationship between stress and performance on neuropsychological tests of attention and memory. However, research in this area has not been directed at the relationship between stress and performance. Further work that corrects methodological problems is necessary as well. Examination of the literature concerning noise, heat, and test anxiety, clearly indicates that the functions of attention and memory are negatively affected under such conditions. In fact, research examining the relationship between stress and tests which are similar to various standard neuropsychological tests have shown definite negative effects -- yet there is no documentation that stress affects specific tests from the WAIS and the Halstead-Reitan Neuropsychological Test Battery. Because little work has been carried out in the specific area of neuropsychological assessment and stress, it seems premature to say that there is a certain relationship between these two constructs.

Neuropsychological testing has traditionally been used to discriminate brain-damaged patients. However, it is possible that those individuals who show neuropsychological deficits upon testing may not have organic deficits but may be exhibiting the effects of some stressor in their lives. Because there is no evidence that such stressors cause any

kind of brain lesion that could cause the behavioral deficits that are picked up by neuropsychological testing, it is possible that stress affects attentional levels, and that this change in attention causes performance deficits. For example, if a person who sustained a closed head injury in an automobile accident shows deficits on neuropsychological tests, it may be because the CNS has itself been damaged, but it also may be because the individual is under considerable stress because of a difficult recovery or because s/he is being sued by an insurance company. The implications of a positive finding on a neuropsychological test and the impact it could have on the way people work and live are potentially great. If neuropsychological testing can be shown to pick up deficits in people with various stressors in their life but no detectable neurological abnormalities, then perhaps misdiagnosis and erroneous treatment/rehabilitation recommendations can be stopped before lives are altered.

Individuals who are undergoing neuropsychological testing are just as likely as anyone to be dealing with major life stressors (eg., impending lumbar puncture; impending examination; death in the family). If those stressors can be identified, and the effects of such stressors reduced, then perhaps their performance on these tests would truly reflect the abilities of these individuals. Because relaxation techniques -- commonly used to decrease high levels of stress -- may produce levels of underarousal which produce poor performance, distraction may be able to reduce the time spent

thinking of the stressor, and in turn reduce stress levels and ensuing performance deficits.

## Hypotheses

1. An acute stressor (a film of combat surgery) and the anticipation of a longer stressor would produce performance deficits in neuropsychological tests of attention and memory in healthy adults. Specifically, subjects in the stress groups (stress/distraction and stress/no distraction) would perform less well on the neuropsychological tests than would subjects in the non-stress groups.

2. The presence of a distraction during the anticipatory stress period would cause a decrease in stress levels and therefore performance deficits on these tests because the subjects had less time to think about the stressor and therefore would be less stressed and show fewer performance deficits. Specifically, it was predicted that neuropsychological performance would be better for the subjects in the stress/distraction condition than in the stress/no distraction condition, and that distraction would have no effect (eg., no performance deficits) on the subjects in the non-stress conditions.

To fully examine any potential main effects of stress and/or the presence of a distraction, various background variables were examined. These included demographic information (eg., age, marital and educational status), number of recent life events, and level of perceived control.

3. The relationship between the severity of life events and the neuropsychological test scores would be negative: the more severe life events an individual had experienced, the worse would be their test performance.

4. The relationship between the level of perceived stress and the neuropsychological test scores would be negative: the lower the level of perceived control, the worse the neuropsychological test scores.

## Methods

### Overview

This study examined the effects of stress on neuropsychological performance by using a combat surgery film stressor and measuring subjects' performance on a battery of neuropsychological tests and a mood assessment questionnaire before and after this stressor. The study also examined whether distraction could reduce the effects of stress on neuropsychological test performance by distracting half the subjects during an anticipatory stress period and then administering the second set of neuropsychological tests, while leaving the other subjects alone during this period. Subjects were told in the cover story that the purpose of the study was to examine the relationship between performance and different cognitive tasks. Physiological measures were also used to assess the effects of the stress manipulation.

### Subjects

Seventy-two subjects participated in this study (36 men and 36 women) ranging in age from 18 to 50 years. A power analysis was performed to determine the sample size necessary to reach a significance criterion of alpha=.05, with eight independent variables (age, education, Perceived Stress Scale score, Life Events score, POMS score, distraction, stress, and distraction X stress interaction), a power of .80, and an effect size of .25. This analysis indicated that 72 subjects would be needed to obtain the indicated level of significance

for these eight independent variables.

Subjects were recruited from the Washington, DC and San Antonio, TX metropolitan areas through newspaper advertisements in the Washington Post, the San Antonio Express-News, as well as by word-of-mouth within the communities. Subjects were screened over the phone using the exclusion criteria summarized in Table 1. The information obtained from the screening was used to ensure a relatively homogenous subject sample with respect to normal brain functioning, as well as to ensure matching of subjects for sex, by excluding any potential subject who met one or more of the exclusion criteria. Potential subjects were told that the screening information was necessary to establish their eligibility for this particular study; they were also assured that any and all information given would be kept strictly confidential. Therefore, they did not give their name until the end of the screening, and then only if they qualified for the study. This assured anonymity to those subjects who did not qualify for the study (except if the potential subject needed to be called back by the Experimenter to complete the screening).

If a subject met the above inclusion criteria, he or she was asked to participate in a study of cognitive performance. The potential subjects were read the following statement over the phone: "I am interested in examining performance on several measures of cognitive functioning, and discovering whether performance on these tests is affected by different

tasks". Subjects were then told that they would be paid $25 for participating in this study, which would last for approximately ninety minutes. The study was conducted in the Department of Medical Psychology at USUHS and on Ward 7D at Wilford Hall Medical Center at a time that was convenient for each subject.

Design

A 2 X 2 factorial design created by crossing stress (stress or no stress) with the presence of a distraction (distraction or no distraction) was used. Males and females were equally and randomly assigned to each of the four conditions. Thus, there were 18 subjects in each of the four conditions, each consisting of approximately even numbers of men and women. All subjects were blind to condition and hypotheses.

Measures

Neuropsychological measures. A brief battery of four neuropsychological tests was given at two distinct times in order to measure the effects of stress on neuropsychological performance: before the film; and after the film/anticipatory period (See Appendix A for measures). These four tests are sensitive measures of attention and memory, and were administered to discover what, if any, effect the film stressor and the anticipation of the longer film had on neuropsychological performance. The Digit Span test from the

WAIS (Weschler, 1955) and the WAIS-R (Weschler, 1981) were used to assess memory and attention performance. The test was made up of two subtests: Digits Forward and Digits Backward, both part of the "verbal" section of the WAIS and the WAIS-R. Each subtest was composed of seven pairs of random number sequences (increasing in length) which were read aloud by the Experimenter; the subjects were asked to repeat these sequences in the exact order that the numbers were read for the forward subtest, and in the exact reverse order for the backward test. Each time the subjects got at least one of the two sequences for each pair correct, another sequence was read aloud which was one digit longer than the previous sequence. This progression was continued until the subjects got both trials of a sequence incorrect, at which point the test was concluded. The highest number of digits the subjects correctly remembered was the score. Two different versions of this test were used for the baseline and anticipatory/post-stressor measurements.

The Trail Making Test (forms A and B) was originally part of the Army Individual Test Battery (1944), and then was incorporated into the Halstead-Reitan Neuropsychological Test Battery (Reitan, 1969). It is a test of attention, visuomotor tracking (the ability to visually follow a stimulus and respond physically) and motor speed (the speed with which a physical task is carried out). In the first part of the test, the subjects were asked to draw lines to connect encircled numbers in sequential order. Part B maintained the same

principle, but required the subjects to draw lines from a circled number to a circled letter in consecutive order (eg., 1 to A to 2 to B, etc.). The times needed to finish each part of the test and the number of errors committed were the subjects scores.

A cancellation task (Lezak, 1983) was used as a measure of attention (sustained vigilance). In this task, the subjects were presented with a page of numbers and asked to cross out certain "target" numbers -- in this case, the subjects were to cross out all the 3's and 8's (or 2's and 5's for the second administration). The subjects were timed, and the time taken to complete the task was obtained. The other score obtained from the cancellation task was the number of errors; this score was broken down into the number of false positives and false negatives carried out by the subjects.

Finally, a word list learning test was administered in order to assess general memory functions. The Auditory-Verbal Learning Test (AVLT; Rey, 1964) was used to evaluate immediate memory span. The test consisted of five presentations and then an immediate recall of a list of 15 words. Two different lists were used for the two administrations. (Note: whenever there were two forms of a test, the order of the forms was counterbalanced between the two neuropsychological test administrations to avoid any possible order effects of these tests.)

Self report measures. Four questionnaires were given to subjects in all conditions after the first set of

neuropsychological tests (See Appendix B). These questionnaires measured general background information, recent life events and levels of perceived stress, as well as mood. A background questionnaire was developed for this study to assess relevant demographic information about the subjects, such as education, marital status, age, and occupation. These variables were used to assess whether any effects found in this study could be due to demographic variables such as education or age, as well as or instead of the manipulations. The Schedule of Recent Experiences (SRE; Holmes & Rahe, 1967) was administered in order to measure the frequency and the impact of specific life change events. This questionnaire was given to the subjects to assess whether these life events impact upon the subjects' performance on the neuropsychological tests. The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was given to the subjects in order to measure the amount of stress they experienced in the month prior to the experimental session, as well as to determine whether this perceived stress influenced their performance on the neuropsychological tests. Mood was measured by the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971); this questionnaire was also used to check whether the film stressor was successful in manipulating the subjects' affective state.

The background questionnaire, the SRE, and the Perceived Stress Scale were given only once during the experimental session for each condition. The POMS was given at the

beginning of the experimental session (eg., just before the resting heart rate and blood pressure baseline period), and also at the end of each neuropsychological testing session (before and after the anticipatory period). Thus, the POMS was administered three times. A brief eight-item Distraction Questionnaire (DQ; developed for this study) was also administered at the end of each set of neuropsychological tests. Primarily, the DQ was designed to assess subjects' self-reported levels of stress and distraction immediately following the anticipatory period, as well as just prior to the end of the session. However, the DQ also assessed the amount of thought directed to the previous film, as well as the next film, the levels of discomfort, attention, enjoyability and interest in the film just seen, as well as how stressful would the next film be. These questions were accompanied by a seven point Likert scale for subjects' responses (from 1=not at all to 7=extremely).

Film Stressor and Distraction

Anticipation of viewing a 60-minute film of graphic combat surgery was used as part of the stressor in this study. To reduce any uncertainty the subjects might have about the contents of this film, they were shown a brief five-minute clip of the film about 30 minutes before the expected viewing, which constituted the other part of the stressor. The film was shown on a video monitor on a table across from the subjects in the two stress conditions. The subjects who were

not in the stress conditions were also told that they would view a film, but instead of the combat surgery film, they were told that they would view a 60- minute nature film. As in the stress conditions, these subjects were shown a brief five minute clip beforehand to reduce possible uncertainty about what they will supposedly be watching. Because this study utilized the anticipatory threat construct, subjects were tested before they saw the long film. However, the long film was not actually shown to the subjects, as at this point the experiment was over.

The distraction that was used for two of the groups was a 15-minute written essay describing the testing room where the subjects were sitting. They were asked to describe in detail the room in which they sat. This distraction was performed after the viewing of the film clip and before the supposed viewing of the full length film. This presence of a distraction during the anticipatory period was hypothesized to decrease the time spent thinking about the stressor, in turn decreasing levels of stress and reducing performance deficits associated with stress. The other two groups (the non-distraction groups) were simply asked to sit quietly for the 15 minutes, in order to focus and maximize the subjects' attention on the full length film stressor which was about to occur.

Manipulation Check. In order to determine the effects of the film stressor manipulation, the subjects' heart rate and blood pressure were measured using a Space Labs Blood Pressure

Monitor at the USUHS site, and an IVAC Vital Check 4200 at the San Antonio site. The monitor was attached to the subjects after their introduction to the study, and was left in place to record the subjects' blood pressure and heart rate every three minutes during the initial baseline rest period (15 minutes duration) and during the anticipatory period before the hypothetical film stressor, and every five minutes for the rest of the experimental session. This device provided readings for the initial baseline period, the film clip, the anticipatory stress period, and the brief final post-stressor period for all four conditions. The subjects remained seated throughout the entire experimental procedure, so the blood pressure and heart rate readings would not be affected by any change in position. The POMS and the Distraction Questionnaire were also used to check the successfulness of the experimental manipulation.

## Procedure

This study was conducted at USUHS on the campus of Bethesda Naval Hospital in Bethesda, Maryland, and at Wilford Hall Air Force Medical Center on the campus of Lackland Air Force Base in San Antonio, Texas. Three subjects were seen at the USUHS site, while the remaining 69 subjects were seen at the Wilford Hall site. When the subjects arrived, they were taken to the testing room and asked to sit down and make themselves comfortable. The experimenter sat down with them, described the study, and then explained the consent form.

Subjects were required to sign the consent form in order to continue with the study.

Overview of Basic Procedure. After signing the consent form, all subjects were attached to the blood pressure monitor, and then filled out the first POMS. They then sat quietly for 15 minutes for the BP and HR baseline period. The first set of neuropsychological tests was then administered. The subjects then filled out the three self-report measures (Background Questionnaire, Perceived Stress Scale and Life Events Scale) and the second POMS. They were then shown either a nature or combat surgery film. Following the film, half the subjects sat quietly for 15 minutes, while the other half of the subjects were administered the distraction manipulation. All subjects were then asked to fill out the first DQ, the final POMS, the final set of neuropsychological tests, and the second and final DQ. The blood pressure monitor was then removed from the subjects, and they were debriefed, paid and thanked for their participation. A more detailed outline of each of the four experimental groups is presented below. (See Figures 1-4 for outlines of experimental sessions for each of the four groups.)

Stress-Distraction Group. This group was told the following: "I am interested in evaluating your performance on several tests of cognition. During the next half hour or so, you will fill out several questionnaires about yourself and complete a few cognitive tests. After that, we will continue. First, I am going to ask you to fill out this brief

questionnaire (POMS #1), and then I will attach you to this automatic blood pressure monitor. We will need to measure your blood pressure during the study. It will not hurt at all, although you may feel a little discomfort when the blood pressure cuff inflates fully -- it will simply record your heart rate and blood pressure automatically every three minutes for the next 15 minutes while you sit quietly, and then every five minutes afterwards so I do not have to do it by hand". At this point, the blood pressure monitor was attached to the subjects, and the subjects were asked to sit quietly for 15 minutes to obtain resting baseline measures of heart rate and blood pressure. They were then given the four neuropsychological tests. Following the completion of these tests, the subjects were administered the background questionnaire, the SRE, the Perceived Stress Scale, and the second POMS.

When the subjects had finished these tests, the Experimenter said: "In 30 minutes, I am going to show you a 60 minute film of rather graphic combat surgery. I will now show you a brief clip of the film, so you will know what it will be like. (FIVE MINUTE FILM CLIP SHOWN). As I said, it was rather detailed and graphic. Before I show you the film, I would like you to write an essay that describes this room in detail. Please begin now". The Experimenter then set the blood pressure monitor to take readings every three minutes as the subjects wrote their essays.

After 15 minutes, the Experimenter reset the blood

pressure monitor to take readings every five minutes, and then administered the first DQ, the third POMS, the last set of neuropsychological tests, and then the second distraction questionnaire. After the tests were completed, the subjects were unattached from the blood pressure monitor, debriefed, paid $25, and thanked for their participation in the study.

Stress-No Distraction Group. This group was told the following: "I am interested in evaluating your performance on several tests of cognition. During the next half hour or so, you will fill out several questionnaires about yourself and complete a few cognitive tests. After that, we will continue. First, I am going to ask you to fill out this brief questionnaire (POMS #1), and then I will attach you to this automatic blood pressure monitor. We will need to measure your blood pressure during the study. It will not hurt at all, although you may feel a little discomfort when the blood pressure cuff inflates fully -- it will simply record your heart rate and blood pressure automatically every three minutes for the next 15 minutes while you sit quietly, and then every five minutes afterwards so I do not have to do it by hand". At this point, the blood pressure monitor was attached to the subjects, and the subjects were asked to sit quietly for 15 minutes to obtain resting baseline measures of heart rate and blood pressure. They were then given the four neuropsychological tests. Following the completion of these tests, the subjects were administered the background questionnaire, the SRE, the Perceived Stress Scale, and the

second POMS.

When the subjects had finished these tests, the Experimenter said: "In 30 minutes, I am going to show you a 60 minute film of rather graphic combat surgery. I will now show you a brief clip of the film, so you will know what it will be like. (FIVE MINUTE FILM CLIP SHOWN). As I said, it was rather detailed and graphic. I will be starting the film soon -- you can relax for a few minutes now." The Experimenter set the blood pressure monitor to take readings every three minutes, and the subjects were asked to sit quietly for 15 minutes.

After 15 minutes, the Experimenter reset the blood pressure monitor to take readings every five minutes, and then administered the first DQ, the third POMS, the last set of neuropsychological tests, and the second distraction questionnaire. When the subjects finished, they were unattached from the blood pressure monitor, debriefed, paid $25, and thanked for their participation in the study.

<u>No Stress-Distraction Group</u>. This group was told the following: "I am interested in evaluating your performance on several tests of cognition. During the next half hour or so, you will fill out several questionnaires about yourself and complete a few cognitive tests. After that, we will continue. First, I am going to ask you to fill out this brief questionnaire (POMS #1), and then I will attach you to this automatic blood pressure monitor. We will need to measure your blood pressure during the study. It will not hurt at

all, although you may feel a little discomfort when the blood pressure cuff inflates fully -- it will simply record your heart rate and blood pressure automatically every three minutes for the next 15 minutes while you sit quietly, and then every five minutes afterwards so I do not have to do it by hand". At this point, the blood pressure monitor was attached to the subjects, and the subjects were asked to sit quietly for 15 minutes to obtain resting baseline measures of heart rate and blood pressure. They were then given the four neuropsychological tests. Following the completion of these tests, the subjects were administered the background questionnaire, the SRE, the Perceived Stress Scale, and the second POMS.

When the subjects finished these tests, the Experimenter said: "In 30 minutes, I am going to show you a 60 minute film of nature scenes. I will now show you a brief clip of the film, so you will know what it will be like. (FIVE MINUTE FILM CLIP SHOWN). I will be starting the film soon. In the meantime, I would like you to write an essay about this room in which you are sitting. Please begin now". The Experimenter then set the blood pressure monitor to take readings every three minutes while the subjects wrote their essays.

After 15 minutes, the Experimenter reset the blood pressure monitor to take readings every 5 minutes, and administered the first DQ, the third POMS, the last set of neuropsychological tests, and the second distraction

questionnaire. When the subjects were finished, they were unattached from the blood pressure monitor, debriefed, paid $25, and thanked for their participation in the study.

<u>No Stress-No Distraction Group</u>. This group was told the following: "I am interested in evaluating your performance on several tests of cognition. During the next half hour or so, you will fill out several questionnaires about yourself and complete a few cognitive tests. After that, we will continue. First, I am going to ask you to fill out this brief questionnaire (POMS #1), and then I will attach you to this automatic blood pressure monitor. We will need to measure your blood pressure during the study. It will not hurt at all, although you may feel a little discomfort when the blood pressure cuff inflates fully -- it will simply record your heart rate and blood pressure automatically every three minutes for the next 15 minutes while you sit quietly, and then every five minutes afterwards so I do not have to do it by hand". At this point, the blood pressure monitor was attached to the subjects, and the subjects were asked to sit quietly for 15 minutes to obtain resting baseline measures of heart rate and blood pressure. They were then given the four neuropsychological tests. Following the completion of these tests, the subjects were administered the background questionnaire, the SRE, the Perceived Stress Scale, and the second POMS.

When the subjects finished these tests, the Experimenter said: "In 30 minutes, I am going to show you a 60 minute film

of nature scenes. I will now show you a brief clip of the film, so you will know what it will be like. (FIVE MINUTE FILM CLIP SHOWN). I will be starting the film soon -- you can relax for a few minutes now." The Experimenter then set the blood pressure monitor to take readings every three minutes, and the subjects were asked to sit quietly until the film began.

After 15 minutes, the Experimenter reset the blood pressure monitor to take readings every five minutes, and then administered the first DQ, the third POMS, the last set of neuropsychological tests, and the second distraction questionnaire. When the subjects were finished, they were unattached from the blood pressure monitor, debriefed, paid $25, and thanked for their participation in the study.

To summarize, all groups followed the exact same procedure, except for which film they viewed and whether or not they were distracted during the anticipatory stress period. The stress/distraction group watched the combat surgery film and was distracted during the anticipatory period, while the stress/no distraction group was not distracted during this period. Similarly, the no-stress/distraction group watched the nature film and was distracted during the anticipatory period, while the no stress/no distraction group was not distracted during this period.

In terms of the time differential between the groups for the neuropsychological measurements, there were approximately

35 minutes between the two neuropsychological testings. Because the neuropsychological tests administered in these testing sessions have been carefully controlled for practice effects, it is hoped that this time differential would be sufficient to allow any effects which stress may have on neuropsychological tests to be measured.

## Results

### Data Analyses

This research addressed hypotheses concerning the effects of stress and distraction on neuropsychological test performance in healthy adults. Condition comparability was assessed for various background measures at baseline, such as age, race, education level, and handedness. Both the actual scores as well as change scores (from baseline or second of three administrations, as in the case of the POMS) were examined in the analyses that are described below.

All variables -- including the initial scores on the POMS, Distraction Questionnaire and neuropsychological tests, as well as the scores on the Life Events Survey (LES), Perceived Stress Scale (PSS), and baseline physiological measures -- were examined with multivariate analysis of variance (MANOVA) for effects of stress, distraction and sex at baseline.

Data from the physiological assessments were analyzed with a repeated measures multivariate analysis of covariance (MANCOVA). To statistically account for variance contributed by baseline differences between subjects, baseline measures were entered as covariates. Stress (stress versus no stress) and distraction (distraction versus no distraction) were entered as between subject factors and time was entered as a within subjects factor. Sex (male versus female), stress (stress versus no stress) and distraction (distraction versus

no distraction) were also entered into a separate 2X2X2 MANCOVA with time again entered as a within subjects factor, with baseline entered as a covariate. For further analyses of the physiological data, change from baseline was assessed with a MANCOVA (2X2 design), with baseline entered as a covariate for the main effects analysis, and a MANCOVA (2X2X2) design was also created for the sex-stress-distraction analysis. For these analyses, the baseline measurement was the average of the last two readings of the five baseline measures of heart rate (HR) and blood pressure. The baseline measure was a measure of the heart rate and systolic and diastolic blood pressure (SBP, DBP) after subjects had been seated and quiet for approximately 12 minutes after the beginning of the study. The other measures of physiological data were arrived at by averaging readings within distinct time periods of the study. The measures that were analyzed here as part of the post-film manipulation check were from the film, three anticipatory periods and the period containing the last set of neuropsychological tests (each the average of two readings per period).

Neuropsychological test performance, as well as scores from the Distraction Questionnaire (DQ) and the Profile of Mood States (POMS), were analyzed with a 2X2X2 MANCOVA for main effects of stress and distraction over time. For these MANCOVAs, baseline measures were entered as covariates. To answer the two specific hypotheses concerning performance of the two stress conditions, and also performance of the two no

stress conditions, two univariate ANCOVAs were performed, using condition (stress-distraction versus stress-no distraction; and no stress-distraction versus no stress-no distraction) with baseline measures entered as covariates.

Multiple regression/correlation (MRC) analyses were carried out with the total score from the Perceived Stress questionnaire, and three scores from the life events scale (number of life events in past six months; total adjustment score; number of life events in past 24 months). The initial neuropsychological scores were evaluated with a hierarchical MRC for the contributions of the PSS, total number of life events in the past six months, adjustment score for the LES, total number of life events in past two years, and sex (in that order). These variables were also entered hierarchically (along with the scores on the initial neuropsychological tests) to evaluate the proportion of variance (change in $R^2$) that each of these factors accounted for in the total variance of the second set of neuropsychological variables and of the change scores (T2 score - T1 score) over and above that accounted for by the first set of neuropsychological test scores (which were entered first into the MRC equation).

Finally, MRC analyses were carried out on the scores from the first and second set of neuropsychological test scores, with distraction, stress, the stress X distraction interaction and sex entered hierarchically (in that order) to again evaluate the proportion of variance that each of these factors accounted for in the total variance of these variables. The

stress X distraction interaction was coded as described by Cohen and Cohen (1983) in their discussion of factorial designs and the coding of interactions. All data analyses were carried out using the Statistical Package for the Social Sciences-X (SPSS-X) data analytic package (SPSS, INC., 1988).

Comparability of Conditions

There were no significant differences for age, race, handedness, marital status, employment status, and education level. There were nine men and nine women in each of the four experimental conditions, and the average age was 32 years old (range 18-48 years). The majority (75 percent) of the sample cited Caucasian as their racial origin, while 22 percent cited Hispanic, and 1.4 percent each reported Black and Oriental ethnicity. Ninety-four percent of the sample was right handed. Sixty one percent of the subjects were married, 24 percent of the subjects were single, 11 percent were divorced/separated, and four percent lived with a partner. Seventy percent currently held a job, and the average number of years of education was 14.4 years (range 10-18 years). To decrease the likelihood of any practice effects on the performance tests, there were two versions of these tests. Subjects were randomly administered one battery of tests or another first, and the remaining battery of tests was administered second.

Manipulation Checks

To determine whether or not the experimental manipulation was successful, physiological and self-report measures were assessed. Subjects completed the POMS at the beginning of the experimental session, before the film, and then just before the end of the experimental session, in order to examine their mood throughout the session. Subjects' levels of tension, anger, vigor, fatigue, confusion and depression were assessed with the POMS, with particular attention paid to the tension scale to ensure that those subjects in the stress conditions were indeed more tense after the stressful film than before the film.

Subjects also filled out a brief 8-item Distraction Questionnaire (DQ) at two times during the session: immediately following the distraction/anticipatory period, and just prior to the debriefing at the session's end. The two primary items of interest from the DQ that assess subjects' self-reported levels of stress and distraction are DQ item #2, "How stressed did you feel in the past 15 minutes?", and item #5, "How distracted did you feel in the past 15 minutes?". All eight items of this scale were scored on a seven-point Likert scale (1=not at all; 7=extremely). These two items were examined to determine whether the stress conditions (stress-distraction; stress-no distraction) reported more stress after the combat surgery film, and whether the distracted conditions (no stress-distraction; stress-distraction) were distracted during the post-film anticipatory period. Heart

rate and blood pressure were also examined to ensure that those subjects in the stress conditions were experiencing a commensurate increase in these physiological measures characteristic of high stress situations during and after the film.

Profile of Mood States. At baseline, there were no differences between the four experimental conditions for any of the six POMS scales. When examined for any possible sex differences, the tension, vigor, fatigue, depression and anger scales showed no differences. The only significant effect of gender on the initial POMS administration was for the confusion/bewilderment scale, $F(1,69)=4.99$, $p<.03$ (see Figure 5). Men's confusion levels were higher at the initial POMS administration than were women's levels ($M$ for men=5.2, $M$ for women=3.5). No other significant gender effect was found at the initial POMS administration.

Of the six POMS scales, only the tension-anxiety scale varied systematically as a function of stress and distraction over the three administrations (see Figure 6). There was a significant main effect for stress, $F(1,64)=5.23$, $p<.03$, a significant main effect for distraction, $F(1,64)=7.67$, $p<.01$, and a significant stress X distraction interaction, $F(1,64)=4.65$, $p<.04$ for the tension-anxiety scale. When Tukey *post hocs* were used to examine this interaction effect, the stress-no distraction condition reported significantly more tension/anxiety symptoms than did the stress-distraction group after the distraction manipulation was performed (See Table

2). In other words, self-reported tension/anxiety was higher in the stress group that did not receive the distraction manipulation than in the stress group that did receive this manipulation.

There was also a stress X time interaction, $\underline{F}(2,130)=9.51$, $\underline{p}<.001$, a distraction X time interaction, $\underline{F}(2,130)=4.86$, $\underline{p}<.01$, and a stress X distraction X time interaction, $\underline{F}(2,130)=3.09$, $\underline{p}<.05$, with the stress-no distraction group reporting higher levels of tension over the experimental session while the other three conditions reported decreasing levels of tension over the same period. No other POMS scale showed a stress X time effect, distraction X time effect, or stress X distraction X time interaction.

When the change from initial to pre-film administration of the POMS was examined (with initial levels entered as covariates), there was no effect of stress or distraction on the vigor, anger, fatigue, confusion, and depression scales. The tension scale showed a significant stress main effect, $\underline{F}(1,64)=4.97$, $\underline{p}<.03$ (see Figure 7), with only the stress-no distraction condition reporting an increase during that time period, while the other conditions reported decreases in tension levels over that same time period. The only main effect of distraction for this initial-to-prefilm POMS was also found on the tension/anxiety scale, $\underline{F}(1,64)=5.52$, $\underline{p}<.03$, with both distraction groups reducing their levels of self-reported tension/anxiety at the second, pre-film administration. There were no stress X distraction

interactions.

When the change from pre-film to post-film POMS was examined (with initial levels entered as covariates), again only the Tension/Anxiety scale showed an effect of stress, $\underline{F}(1,64)=11.54$, $\underline{p}<.01$ (see Figure 8). Both stress conditions reported an increase in levels of tension, with the stress-no distraction condition reporting more tension than the stress-distraction condition. There was no effect of distraction, and no stress X distraction interaction.

Distraction Questionnaire. As well as evaluating how stressed and distracted the subjects were at two distinct points in the experimental session, the DQ assessed interest, attention, discomfort and enjoyment, and also included questions which assessed how stressful the next film would be, and how much thought was given to the next film. These two questions were inserted to help the subjects believe that they would be seeing more of the film in the future.

When initial scores (here, immediately post anticipatory period) on the eight questions were examined, there were several differences between the groups. DQ #2 (how stressed did you feel in the past 15 minutes?) showed a significant effect of stress, $\underline{F}(1,67)=4.64$, $\underline{p}<.04$ (see Figure 9). Tukey *post hocs* showed that the no stress-no distraction condition reported feeling less stressed than did the stress-no distraction condition ($\underline{M}$s=1.6, 2.9, respectively). The other major question of interest (DQ #5), "how distracted were you in the past 15 minutes?", showed no differences among the four

conditions. The distraction conditions were hypothesized to experience higher levels of distraction during this period than the non-distraction conditions.

One main effect of distraction emerged for the initial DQ administration. A significant main effect of distraction was found for discomfort felt during the film (DQ #3), $F(1,67)=.64$, $p<.04$, but Tukey *post hocs* revealed no significant differences among the four conditions. Several items showed main effects of stress. A significant main effect of stress was found for item #4, which assessed the enjoyability of the film, $F(1,67)=22.10$, $p<.001$ (see Figure 10). *Post hocs* revealed that the two groups who watched the combat surgery film found the film less enjoyable ($M$ for the stress-no distraction group=1.3, $M$ for the stress-distraction group=1.4) than the groups who watched the travel film ($M$ for the no stress-no distraction group=2.7, $M$ for the no stress-distraction group= 2.2). Similarly, a significant stress main effect was found for DQ #7, "how stressful will the next film be?", $F(1,67)=23.25$, $p<.001$ (see Figure 11). *Post hocs* showed that the two conditions that saw the surgery film felt that the next film they saw would be significantly more stressful than did those in the two conditions who saw the travel film (no stress-no distraction $M$=1.9, no stress-distraction $M$=1.9, stress-no distraction $M$=3.8, stress-distraction $M$=3.4). DQ #8, which assessed how much attention was paid to the film just watched, also showed a significant stress effect, $F(1,67)=14.87$, $p<.001$ (see Figure 12). *Post hocs* showed that

the no stress-no distraction condition ($\underline{M}$=4.3) paid significantly less attention to the travel film than both the stress-distraction condition and the stress-no distraction condition ($\underline{M}$s=5.6, 6.0, respectively) paid to the surgery film.

There were no effects of sex on the initial DQ items #1-5, 7-8. DQ #6, level of interest in film, showed a significant effect for sex, $\underline{F}(1,69)=6.32$, $\underline{p}<.02$ (see Figure 13). Men in all conditions reported significantly more interest in the films than did the women from these same conditions. The only sex x condition interaction for the initial DQ was for the first item, amount of thought about the next film, $\underline{F}(1,71)=2.94$, $\underline{p}<.05$. Men in the stress-distraction condition reported thinking less about the film than did the men in the other three conditions. Females in the two no stress conditions reported thinking about the film less than those females in the stress conditions.

When repeated measures MANCOVAs were performed on the DQ to search for main effects of stress, distraction, and possible stress X distraction interactions (with baseline held constant), no significant effects were found for DQ items 1,2,4,6 and 8. DQ #3, which assessed level of discomfort, showed a significant distraction X time interaction, $\underline{F}(1,68)=5.86$, $\underline{p}<.02$ (see Figure 14). The stress-distraction group decreased self-reported discomfort from the time the first DQ was administered to the time the second DQ was administered, while the other three groups all reported more

discomfort over the same period. DQ #5 (amount of distraction felt in past 15 minutes) showed a main effect of stress, $\underline{F}(1,67)=5.46$, $\underline{p}<.03$, and a stress X time interaction, $\underline{F}(1,67)=6.28$, $\underline{p}<.02$ (see Figure 15), with the stress-distraction group again appearing to decrease its level of distraction between administrations, while the other three groups increased their reported level of distraction over the same time. Finally DQ #7 (how stressful the next film would be) showed a main effect of stress, $\underline{F}(1,67)=5.11$, $\underline{p}<.03$ (see Figure 16). The two groups that watched the surgery film appeared to experience increases in anticipated stressfulness over time, while the two groups who viewed the travel film appeared to remain at the same level over the same time period.

When change from initial to final DQ administration was examined (with initial levels entered as covariates), only three items showed significant effects. DQ #5, the item which assessed self-reported level of distraction, showed a significant main effect of stress, $\underline{F}(1,58)=5.51$, $\underline{p}<.03$ (see Figure 17). Tukey *post hocs* revealed that the stress-distraction condition decreased its self-reported levels of distraction from first to second administration, while the no stress-no distraction condition reported an increase in distraction. Two interaction effects (stress X distraction) were also revealed. DQ#2, which measured level of stress, showed a significant interaction effect, $\underline{F}(1,58)=4.09$, $\underline{p}<.05$ (See Figure 18). DQ #3, which assessed discomfort, also

showed a significant interaction effect, $F(1,58)=4.95$, $p<.04$ (See Figure 19). For both these DQ items, levels of self-reported stress and discomfort increased from the initial administration for all groups but the stress-distraction group. The scores on both items for this group between the first and second administrations decreased. In other words, self-reported levels of both stress and discomfort decreased between the administrations for the stress-distraction group. No main effect of distraction was found for any DQ item.

Physiological Response. There were no differences among the experimental conditions at baseline for heart rate (HR), systolic blood pressure (SBP), or diastolic blood pressure (DBP). Examination of sex differences between the conditions at baseline by ANOVA showed a significant effect of gender for SBP, $F(1,67)=10.72$, $p<.01$. Men exhibited higher systolic blood pressure at baseline than women ($M$ SBP for men=124.4mmHg; $M$ SBP for women=112.3mmHg). There were no significant differences between men and women for baseline HR and DBP.

A main effects MANCOVA was performed on the averaged physiological readings from the film to the end of the experiment to examine possible stress or distraction effects (with baseline values entered as covariates). There were no effects of stress, or of the stress X distraction interaction for any of the physiological variables of SBP, DBP, and HR. There was an effect of distraction on SBP, $F(1,62)=4.04$, $p<.05$, and on HR, $F(1,62)=4.32$, $p<.05$ (see Figures 20 and 21).

Both distraction conditions (stress-distraction and no stress-distraction) had higher levels of SBP and HR during the post-film period than did the conditions who did not receive the distraction manipulation.

These results indicated that BP and HR were unaffected by the stress manipulation. However, subjects in the two conditions that received the distraction manipulation exhibited higher SBP and HR than did subjects who did not receive this manipulation.

Summary. Self-report manipulation checks showed that subjects receiving the stress manipulation were more stressed than those not receiving the stress manipulation, as evidenced by the effects of stress on the POMS tension/anxiety scale, and DQ item #2, which revealed that the stress-no distraction condition was more stressed than the no stress-no distraction conditions. The distraction manipulation did not appear to have been successful, as DQ item #5 (which assessed level of distraction after the manipulation) did not show any main effects of distraction: there were no differences between the four experimental groups. In fact, the stress-distraction group reported less distraction over time than did the other three groups, as measured by DQ item #5. However, from the POMS Tension/Anxiety scale data, the stress-no distraction group reported more tension/anxiety symptoms than the stress-distraction condition. So, while the subjects did not report increased levels of self-reported distraction, they did report fewer symptoms of stress after the stress/distraction

manipulations. Finally, the physiological data showed no effect of stress; that is, the stress groups did not differ from the no stress groups on HR, SBP, or DBP. SBP and HR did show an effect of distraction, with both groups who received the distraction manipulation exhibiting higher SBP and HR than the no distraction groups.

Therefore, it appears that the stress manipulation was successful in increasing levels of self-reported stress in the stress groups, but not successful in elevating their BP or HR as was predicted. The distraction manipulation does not appear to have been successful.

Psychosocial Questionnaires

Schedule of Recent Events. The Schedule of Recent Events (SRE) was used to assess the effect of past life events on neuropsychological test performance. Specifically, it was hypothesized that those individuals with a higher number of life events would perform less well on the tests than would individuals with fewer events. Six scores were obtained from this questionnaire: the number of life events recorded in four six-month intervals: 19-24, 13-18, 7-12, and 0-6 months before testing. Subjects also rated how much adjustment (on a scale of 0-100) was needed to cope with these events; the total of these ratings was recorded for each subject. Finally, the total number of life events for the two years prior to testing was also recorded. The mean number of events in the 19-24 month category was 3.6, with 2.6 for the 13-18 month category, 4.8 for the 7-12 month category, and 8.7 for the 0-6 month

category. The average number of life events within the 24 month time frame was 19.7, and the average total adjustment score was 817.

There were no effects of condition, sex, and no condition x sex interaction for the 13-18 and 0-6 month categories, the total number of life events, and the total adjustment score. There was a significant effect of sex on the 7-12 month category, $\underline{F}(1,64)=4.8$, $\underline{p}<.05$, with men reporting significantly more life events than women during this time frame ($\underline{M}$ for men=5.8 events, $\underline{M}$ for women=3.7 events). There was also a significant effect of sex for the 18-24 month category, $\underline{F}(1,64)=4.9$, $\underline{p}<.05$, with men again reporting significantly more life effects than women.

When multiple regression analyses were performed with the initial scores of the neuropsychological tests as dependent variables, the number of life events in the six months prior to the session accounted for six to twelve percent of the variance of the following variables: Digit Span Forward and Backward scores, Trails A time score, and word lists two through five of the AVLT, $\underline{p}$s<.05 (See Table 6). In all cases, unexpectedly, increasing numbers of life events were associated with improved performance. The total number of life events in the two years prior to the experimental session accounted for six to nine percent of the variance of the following variables: Digit Span Backward actual and scale scores, Trails A and B time scores, and AVLT word lists one through 5, $\underline{p}$s<.03. Here, also, was improved performance

associated with increased numbers of life events.

When multiple regression analyses were performed with the final scores on neuropsychological tests entered as dependent variables, the total adjustment score did not significantly contribute to the variance of any of the test scores (See Table 7). However, number of life events in the six months prior to the experimental session accounted for seven percent of the variance in the Trails A error score (change in $R^2$=.07), $p$<.03. Number of events in the past six months also accounted for seven percent of the variance in the Trails B time score (change in $R^2$=.07), $p$<.01. The total number of life events in the 24 months prior to the experimental session accounted for six percent of the variance in the number of errors on the second Cancellation Test (change in $R^2$=.06), and five percent of the variance (change in $R^2$=.05) of the Cancellation Test time score, ps<.05. The total number of life events also accounted for two percent of the variance (change in $R^2$=.02) of the third AVLT word list, $p$<.03. Again, in all cases, improved performance was associated with increased numbers of life events.

The number of life events (both short-range and long-range) affected performance in a positive way for selected neuropsychological variables at the second administration. In general, an additional two to seven percent of the variance of these tests were accounted for by the number of life events experienced prior to the experimental session over and above that amount of variance explained by the initial test scores.

Unexpectedly, increased numbers of life events was associated with improved performance on the neuropsychological tests.

<u>Perceived Stress Scale.</u> The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was used to assess whether perceived stress affected initial performance on the neuropsychological tests. Specifically, it was hypothesized that high levels of such perceived stress would be related to decreased test performance. The mean score for the scale was 23.6. There were no effects of sex or condition and no sex x condition interaction. Both men and women reported a mean of 23.6 (possible range 0-56) for the total score of the Perceived Stress Scale.

When multiple regression analyses were performed to examine the contribution of perceived stress to the different neuropsychological variables at both initial and second testings as well as the change scores, there were no significant findings (See Tables 6 and 7). Perceived stress, at least as measured here, does not appear to have affected these tests of memory and attention.

<u>Summary.</u> The hypothesis concerning neuropsychological test performance and perceived stress were not confirmed. There was no significant contribution, in any direction, for perceived stress. For life events, a small yet significant amount of the variance of the various neuropsychological measures was accounted for by the number of life events, both two years and six months prior to testing, as well as the life event adjustment score.

Neuropsychological Tests

No differences were observed at initial (baseline) testing with regard to sex, condition, or the sex X condition interaction for any of the performance measures. Sex was found to account for only 6.5 percent of the variance in the Trails A time score (change in $R^2$=.065), $p<.03$. Men performed more slowly than did females on this test. No other neuropsychological variable was significantly affected to by sex.

No main effects of stress or distraction were found for any of these repeated measures neuropsychological variables, with initial scores entered as covariates. The only stress x distraction interaction for these neuropsychological variables was found for the number of errors on the Trails B, $F(1,67)=4.46$, $p<.04$ (see Figure 22). Tukey *post hocs* showed that the no stress-no distraction condition had significantly more errors ($M$=1.3) at the second testing than the stress-no distraction and stress-distraction condition ($M$s=0.1). In other words, more errors were made on the second neuropsychological test by the no stress- no distraction group than were made by the two stress conditions.

When change scores from the first neuropsychological testing to the second testing were examined with a multivariate MANCOVA, no main effects of stress of distraction were found. Additionally, no interaction effect of stress X distraction was found.

When the norms for the Digit Span and the Trails tests

(the only tests used in this study with standardized normative data) were examined, the subjects in all experimental conditions revealed no impaired scores. That is, their scores did not fall in the "impaired" category, which alerts clinical neuropsychologists to abnormal performance. (See Heaton, Grant & Matthews, 1991 and Weschler, 1981 for normative data information.)

The last hypotheses to be addressed examined whether the stress-distraction condition would perform better than the stress-no distraction condition, because the effect of distraction would be to not let the stressor be ruminated about. When the stress-distraction condition was compared with the stress-no distraction condition at the second testing (with first testing scores entered as covariates), there was only one difference between the groups for the neuropsychological test scores: the Digit Span Backward. There was an effect of condition, $\underline{F}(1,35)=4.70$, $\underline{p}<.04$. The stress-no distraction group remembered 4.1 numbers, while the stress-distraction group remembered 4.9 numbers. In other words, the stress-distraction group remembered significantly more numbers on the Digits Backward test than did the stress group who did not receive the distraction manipulation. When change from baseline was examined, the only effect of condition was again seen on the raw score of the Digits-Backward test, ANCOVA $\underline{F}(1,34)=4.69$, $\underline{p}<.05$. The stress-no distraction condition remembered the same amount of numbers from first to second testing, while the stress-distraction

remembered a small but significantly greater amount at the second testing. The other portion of this hypothesis was that there would be no differences in the performance on the neuropsychological tests between the two no-stress conditions (with the baseline score held constant). This portion of the hypotheses was upheld, as there were no differences for either the second set of testing scores, or the change scores (second administration - baseline scores).

Multiple regression analyses showed that stress accounted for two percent of the variance of word list #5 of the AVLT (change in $R^2$=.02), while stress accounted for nine percent of the variance (change in $R^2$=.09) of the change score for this same word list, $p$s<.01, with the stress groups remembering fewer words than the no stress groups over time. The stress X distraction interaction accounted for six percent of the variance (change in $R^2$=.06) of the Trails B error score, while it accounted for four percent of the variance (change in $R^2$= .04) of the Trails B time score, $p$s<.05, with only the no stress-no distraction condition evidencing more errors over time. No other significant contributions of stress, distraction, or the stress X distraction interaction were revealed by MRA for the Time 2 neuropsychological variables, or the change scores for these same variables.

Given that only a very small effect was found for these neuropsychological performance variables, a second power analyses was performed in order to estimate the approximate sample size required to find actual effects. With alpha set

at 0.05, power set at 0.80, and effect size set at 0.15, 480 subjects would have been required to find an effect of stress and distraction on these variables (See Borenstein & Cohen, 1988,6 for more on power analyses computation.)

<u>Summary.</u> No main effects for stress or distraction were seen for any of the neuropsychological test scores. An interaction effect (stress x distraction) was found for the number of errors made on Trails B, indicating that the no stress-no distraction condition performed less well at the second testing than did the stress-no distraction condition. When change scores were examined over time, no main effects of stress or distraction were found, and no stress X distraction interaction was found. No effects of sex or condition were found at baseline.

The hypothesis that the stress-distraction condition would perform better than the stress-no distraction condition was confirmed, but only on one of the 16 neuropsychological variables -- the Digits Backward score. The hypothesis that the two no stress conditions would have comparable performance was also upheld, as again there was no difference between the conditions on any of the test scores

## Discussion

This research was designed and conducted to answer two questions. First, does an acute stressor affect performance on neuropsychological tests of attention and memory? Secondly, could distraction be used to decrease the potentially negative effects of this stressor and produce smaller performance deficits on such tests? The only significant major result of this study indicates that attention, as measured by the Trails B test, was positively affected by the presence of a stressor. Additionally, distraction did not appear to ameliorate the effects of a stressor on the tests assessing memory and attention.

### Effects of stress

Presence of a stressor was predicted to produce performance deficits in tests that measure attention and memory. More specifically, subjects in the two stress conditions were hypothesized to perform less well on these tests than would the subjects in the two no stress conditions. The results of this study did not confirm these hypotheses, and do not corroborate findings from other studies that have shown that stress produces deficits in performance on memory tests (Diethelm and Jones, 1947; Mueller, 1980; Mueller and Overcast, 1976; Pyke and Agnew, 1963). Neither the Auditory-Verbal Learning Test (AVLT) or the Digit Span Test showed any

effect of stress upon memory in this research.

The only major significant finding from the neuropsychological testing showed that the number of errors on Trails B was greater for the group of subjects who experienced neither the stressor or distraction manipulations than for the other three groups. Here, then, attention seemed to be positively affected by the presence of the stressful combat surgery film. This finding is in direct contradiction to research by Klonoff et al. (1976) who showed performance deficits on the Trails test in a high stress group (but not the low stress group) of POWs. However, as suggested earlier, that research did not exclude many of the other variables that could have produced such an effect, such as nutrition. The present study can rule out other extraneous variables, and found few effects of stress on test performance. Examination of the Digits-Forward and cancellation tests revealed no effect of the presence of a stressor on attention. Similarly, examination of the Digits-Backward and AVLT tests did not reveal any significant effect of stress on memory. When averaged scores on the Digit Span and Trails tests were compared with the respective normative data for these tests, no impairment was found.

Why did the results of this research show none of the expected effects of stress? To answer this question, we must first examine whether the stress manipulation was successful; in other words, were the subjects in the two stress conditions actually stressed by the combat surgery film? The data from

the POMS tension scale indicated that subjects in the stress-no distraction condition reported greater increases in stress during the surgery film and anticipatory period than did subjects in the other three groups. The stress-no distraction condition showed an increase in tension from the film to the end of the experimental session, while the other stress group and the two no stress groups showed decreases in tension over the same period. From the DQ, it is apparent that the group that watched the surgery film but was not distracted reported more stress after the anticipatory period than the group who watched the travel film and also was not distracted. The two stress conditions also experienced more anticipatory stress than did the no stress conditions.

However, examination of physiological data was unconvincing. Diastolic blood pressure did not change or show any differences among conditions at any time. Analyses of the systolic blood pressure and heart rate data showed that subjects who received the distraction manipulation exhibited increased systolic blood pressure and heart rate when compared with the two groups that did not receive the manipulation. This suggests that by the time these subjects began the post-film portion of the experiment, their heart rates and systolic blood pressure were significantly increased from baseline.

These data provide some evidence that subjects experienced at least some psychological distress, but no physiological arousal as a function of the stress manipulation. Why then did neuropsychological test

performance not show the expected results? One possible was to examine the relationship between the manipulation check findings is to employ the inverted-U arousal curve (Yerkes & Dodson, 1908). Interpretation of this curve reveals that extreme (high and low) levels of arousal do not result in optimum performance. Upon examination of the physiological data obtained in the present study, both distraction groups (no stress- and stress-distraction) would fall at the higher arousal section of this curve. So, the distraction manipulation _itself_ may have led to increased arousal, not at decreased arousal as was intended. More specifically, the distraction manipulation may have caused arousal in the no stress-distraction group, which was not expected to be at all aroused at the onset of this research study. It is unclear, then, whether the stress-distraction group was aroused because of the combat film, the distraction manipulation, or both.

From the POMS self-report data presented above, the stress-no distraction group was never physiologically aroused, even after viewing the combat film. So, it appears that the manipulations were only weakly successful, as the stress groups did report mores distress after the stressor, but only the stress-distraction group exhibited increased arousal, albeit with the confounding presence of the distraction manipulation. The manipulations, then, did not produce the desired and expected effects. Indeed, the stress-no distraction group was not physiologically aroused, while the no stress-distraction group was unexpectedly aroused.

In accord with this arousal model, then, it appears that the subjects in the no stress-no distraction group may have performed more poorly at the second testing because they were underaroused, while the subjects in the other three conditions did not evidence performance change because they exhibited some form of physiological arousal -- whether from the stress manipulation, the distraction manipulation, or both manipulations working together.

Other research by Wilkinson et al. (1963) demonstrated that there are different stress "tolerance" levels for different tests, that there are different curves or functions of performance for different tests. This notion closely resembles the arousal theory model, whereby extremely high or low levels of arousal cause performance deficits (Kahneman, 1973). This thought could be applied to the findings from this research: because different tests are affected by different components of stressors (intensity and duration, for example), it was possible that the threshold for the tests used in this research was met by the combat surgery film shown to the subjects in the two stress conditions. Alternatively, consistent with Cohen et al. (1986), by re-allocating attention to the more important aspects of a task, the stressor could have caused changes in cognitive strategies. The stressor may not have caused attention to be redirected, perhaps because the film was over well before the second battery of tests was given and the subjects were able to put it out of their minds. Hence, even though stress and tension

levels were elevated, performance levels were not affected. Further research with stressors of varying intensities and durations, for example, may help to further elucidate the relationship between stress and performance.

These possible explanations still do not account for the unexpected finding on the Trails B test. There is some evidence in the literature (Epstein et al., 1980; Hockey and Hamilton, 1970; Wilkinson et al., 1963) for improved performance under stress which could explain the improved performance for the two stress conditions, but not for the decreased performance for the no stress-no distraction condition. The increase in errors, while significant, was very small (from 0.7 to 1.3), and it is not clear that this is a meaningful increase in errors, since upon rounding, both means would be rounded to one error. The rounded means for the other three groups are zero, and the significance of one versus no errors may not be of great practical importance in terms of attention deficits. The time scores rather than the number of errors for the Trails tests are generally used for diagnostic purposes, and because the time scores were not different between the groups, it may be assumed that the difference in the number of errors on Trails B does not indicate a significant impact on performance by the stressor.

Because this was a test-retest experiment, with only about 35 minutes between testings, the novelty of the testing situation must be taken into account. The novelty of the first set of neuropsychological tests surely had worn off by

the time the subjects were asked to do the second, almost identical battery of tests. Pyke and Agnew (1963) showed that shock was only associated with a decrease in performance on the Digit Span test when this test was novel. In their research, when the shock was introduced after repeated administration of the Digit Span, no effect of anxiety due to the shock was found. Thus, while anxiety may impair performance on tasks which are novel (as were the tests in the first battery), tasks which are familiar (such as the tests in the second battery) may not be affected by anxiety.

It appears, then, that the subjects in the stress-no distraction condition were modestly distressed. However, subjects in the stress conditions did not evidence any performance deficits after the stressful combat surgery film was shown. Perhaps this is because the neuropsychological tasks the subjects were asked to perform were familiar (i.e., they had previous experience with them in the first neuropsychological battery before the film). While this may be one plausible explanation for the lack of findings in this study, it would be a factor which would be difficult to eliminate in future research, as the point of repeated measures testing is to aid in comparability of data from each testing. Obviously, if different tests were used at each testing, no such comparisons could be made.

Another test-retest issue is the practice effect. Practice effects have been noted in tests which have a large speed component, have a single solution, or use unfamiliar

response sets (Lezak, 1983). However, great lengths were taken to ensure that practice effects would not confound the results of this experiment. The AVLT has been found to be especially susceptible to practice effects, and it is suggested that different word lists be utilized at repeated testings to avoid this problem. In this research, two separate word lists were indeed used for the AVLT in hopes of countering this effect. Additionally, the Digit Spans used different lists of numbers, and the cancellation test used different target numbers for each testing. Only the Trails A and B did not change between testings. This practice effect could account for the findings on the Trails B test of improved performance for the three conditions, but still could not account for the decreased performance of the no stress-no distraction condition. Therefore, practice effects do not seem to be a viable explanation of these findings.

The stress manipulation appeared to achieve a weak stress effect, as subjects in the stress conditions reported more levels of stress/tension than the no stress conditions, and the stress-distraction condition showed increasing heart rate and systolic blood pressure after the stressful film. However, this cardiovascular arousal appears to have been related to the distraction manipulation, and not the stress manipulation.

Effects of distraction

The presence of distraction during the anticipatory period was predicted to ameliorate the effects of the stressor in the stress condition, therefore reducing the performance deficits on these tests. More specifically, it was predicted that neuropsychological performance would be better for the subjects in the stress-distraction condition than in the stress-no distraction condition, and that distraction would have no effect in terms of such deficits on those subjects in the no stress conditions. The data from this study do not support the notion that distraction ameliorates the effects of stress in the two stress conditions on the neuropsychological tests. Indeed, this study found no effect of the presence of a stressor on such tests. No main effects of distraction were found for any of the test scores, and only one stress x distraction interaction effect was found for these same scores. The number of errors on the Trails B test showed this interaction effect (albeit in the wrong direction), with the no stress-no distraction condition performing more poorly at the second set of neuropsychological tests than at the first, while the other three conditions all improved their performance at the second testing. As noted above, this unpredicted performance deficit may well be due to underarousal.

When the two stress groups were compared, only one difference was found. The raw score (number remembered) of

the Digits Span Backwards test was higher for the stress group that received the distraction manipulation than for the stress group than did not receive this manipulation. With only this one finding out of the many tests that were administered, it does not appear that the subjects in the stress-distraction condition performed substantially better than the subjects in the stress-no distraction condition. The hypothesis that the no stress conditions would perform comparably was upheld, but only in terms of a null finding as again there were no differences between the conditions for any of the neuropsychological test scores.

With this unexpected set of findings, it would be useful to examine whether the distraction manipulation was successful. If success is defined here as the distraction conditions reporting higher levels of distraction after the anticipatory period, then the manipulation was not effective. There was no difference between the groups on the DQ item which assessed the amount of self-reported distraction. However, another way to examine the success of the manipulation is whether the predicted outcome was obtained. After the anticipatory period, the stress-no distraction condition reported higher levels of stress than did the stress-distraction condition. And, both stress conditions found their combat surgery film less enjoyable, paid more attention to it, and thought about the next film more than subjects in the no stress conditions. Upon close examination of the final DQ and POMS scores, the stress-no distraction

condition reported higher levels of tension (from the POMS) than did the stress-distraction condition. Also, the stress-no distraction condition reported higher levels of tension on this third POMS than at the second. So, at the very end of the experimental session, immediately following the second battery of neuropsychological tests, the stress-no distraction condition experienced greater reported tension, while no other group showed the same in that same time period.

Therefore, while it is clear that subjects in the distraction condition did not notice any increase in distraction, the stress group that did not receive the distraction manipulation reported more tension after the second set of neuropsychological tests than after the first set. This group also did not show increased physiological arousal. And, while it is obvious that the distraction manipulation was not as strong as it might have been, or at least not strong enough to produce an increase in distraction in terms of the subjects not registering and reporting increased distraction, perhaps this degree of success was not necessary to achieve the desired outcome. The desired outcome -- decreased stress levels in the condition with the distraction manipulation -- was achieved. But, the distraction groups also exhibited higher levels of SBP and HR over the course of the experiment than the groups without the is manipulation. While the subjects in the distraction conditions could not verbalize their level of distraction, for some reason they did experience a conscious decrease in their

tension levels, while simultaneously exhibiting increased cardiovascular function.

Even with this interpretation, there are few data from this research that would suggest that distraction influenced performance in the stress condition on the tests of attention and memory. However, because no effects of the stressor were found in the predicted direction for any of the neuropsychological variables, it is impossible to say whether or not distraction could ameliorate such effects. Further research is the only way to more fully explore this hypothesis.

Distraction has previously been linked with successful decreases in self-reported pain ratings (Broome et al., 1992; Farthing et al., 1984; Hodes et al., 1990; Marino et al., 1989; Spanos et al., 1984; Wostratzky et al., 1988) and reduced aversive reactions to chemotherapy (Greene et al., 1991; Kolko & Rickard-Figueroa, 1983; Redd & Andrykowski, 1982; Redd et al., 1987). The present research shows that distraction did not affect performance on tests of attention and memory. However, this finding could be directly attributed to the particular conditions in this study, and not applicable to other studies examining distraction as a stress-reducing technique. Whether distraction could play a role in alleviating effects of stress on tests which measure attention and memory is a hypothesis which was not demonstrated here. Only research which focuses primarily on the distraction construct could further elucidate any such relationship.

Life Events and Perceived Stress

It was anticipated that increased numbers of life events, as measured by the Life Events Survey (Holmes and Rahe, 1967), would negatively influence the neuropsychological test scores. When the number of recent life events was examined, a significant portion of the variance (two to twelve percent) was accounted for by recent life events for the various neuropsychological tests. It was hypothesized that the number of life events would have accounted for a larger proportion of the variance in these neuropsychological variables than was found here. However, results from this study indicated that these significant findings occurred in the opposite direction than was predicted. In other words, increasing numbers of life events were associated with improved performance on the neuropsychological tests. This is not at all what would be predicted from the literature, and is not easily explained. Perhaps this increased level of stressful life events produced a sort of "optimum" arousal level (as discussed by Yerkes & Dodson, 1908, and Easterbrook, 1959), thereby producing improved performance on neuropsychological tests. Or perhaps this finding is an oddity, and something that would not be revealed upon further examination. More research in this direction is necessary to elucidate the nature of the relationship that exists between life events and performance on neuropsychological tests of attention and memory.

It was also anticipated that perceived stress, as measured by the Perceived Stress Scale (Cohen, 1983), would

influence performance on these tests, such that those with high levels of perceived stress would perform less well than those with low perceived stress levels. However, there were no significant contributions of perceived stress to any of the neuropsychological tests. This lack of findings suggests that perceived stress -- at least as measured here -- does not affect performance on tests of attention and memory. Additional research which specifically focuses on life events, perceived stress, attention and memory might more effectively investigate the relationship, if one exists, between these constructs.

## Summary and Conclusions

In this research, presence of a stressor (combat surgery film versus a nature film) was crossed with the presence of a distraction (essay versus no essay), in order to examine the effects of such a stressor on the performance on neuropsychological tests of attention and memory, and to also examine whether distraction could ameliorate these potential effects. It was hypothesized that the presence of a stressor would negatively affect such performance, and that distraction could lessen the effects of stress on performance. Results, however, did not at all support the stress hypothesis. Only one test showed any significant differences between the conditions: the Trails B, which measures attention. The Trails B did not show the desired effect: more errors were made by the no stress-no distraction condition at the second post-stressor, post-distraction testing than by the stress-no distraction condition and the stress-distraction condition.

This research suggests that neither memory or attention was negatively affected by the presence of a stressor. This finding, however, is countered by another finding, which shows that the stress manipulation was equivocal. The stress conditions reported higher levels of tension/stress, and the stress-distraction condition even showed an increased heart rate and systolic blood pressure over the post-stressor course of the experiment. The distraction manipulation appears to have caused an increased cardiovascular response, while the

stress manipulation did not produce similar results. So, the criticism that perhaps the stress conditions weren't stressed, and that is why there weren't more findings, is hard to assess. It appears that the subjects were distressed by the combat surgery film, but not cardiovascularly aroused by it.

Other researchers have found many effects of stress on tests of attention and memory, their subject groups exhibited several confounds. Some studies (Mueller, 1980; Mueller and Overcast, 1976) used clinically anxious subjects and compared them with subjects who were not at all anxious. Another study (Diethelm and Jones, 1947) used psychiatric inpatients. Finally, a pair of studies used WWII POWs (Klonoff et al., 1967; Kral et al., 1976). Perhaps it was something special about these groups which caused them to show such performance deficits. The research in this study utilized a non-clinical group with no current or past history of depressive or anxiety illness. This group of healthy volunteers showed no effect of stress on attention or memory.

This is not to say that stress never affects such performance. Perhaps in a real-life setting rather than an obviously contrived experimental situation, different relationships might be found. Perhaps if the stressor were stronger, or lasted longer could there be some other effect. Perhaps if the distraction had been less arousing could some other effect have been found. Further research should be conducted on real-life stressors to examine their effect on

tests of attention and memory.

The distraction hypothesis did not gain any support in this research. There was no main effect of distraction on any variable. In this research, distraction did not ameliorate the effects of stress. While distraction has previously been used to reduce stress in pain and chemotherapy research with great success, no such effect was found here. Perhaps the distraction technique was not strong enough to produce the desired results. Or, perhaps distraction simply does not reduce the effects of stress on neuropsychological tests. However, preliminary research such as this study is not enough to declare that distraction is a failure as a stress-reducing technique. Only more examination will provide the needed answers.

Finally, there was no relationship between perceived stress and neuropsychological test performance, and an unexpected, paradoxical effect of the number of life events on performance. It would appear from the study, then, that perceived stress as measured by the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) has no bearing on tests of attention and memory under stress conditions. The life events findings are not expected from past research in that area -- only further research will help clarify the relationship between these variables.

In conclusion, this is the only reported study to examine the relationship between an acute experimental stressor and neuropsychological tests of attention and memory in healthy

volunteers. It is also the only reported study that examined distraction as a possible means to alleviate such effects of stress on performance. Attention and memory were not negatively affected by stress, and distraction did not affect performance in any wa, although those findings are not definitive, as the manipulation effects seem to have had equivocal results.

Such research, however, is important for all those using neuropsychological techniques in their evaluation of clinical patients or research studies. If the findings of this study can be replicated, then perhaps the lack of stress assessment in clinical and research settings may indeed be valid. Perhaps research such as this can be used to more clearly appreciate the results of neuropsychological testing in both clinical and research settings.

Were the study to be performed again, with the knowledge gleaned from the present effort in hand, several factors could be altered to more convincingly demonstrate the relationship between stress and neuropsychological test performance. First, the type of stressor could be changed, such that the stressor elicited a stronger, more reliable arousal effect, in an attempt to assure that the stressor was more stressful to the subjects than the neuropsychological tests themselves. Secondly, a less distressing distraction could be utilized, so that subjects would not be asked to perform a distressing task as a distraction, thereby confounding any possible effects of the stressor. Lastly, test anxiety could be measured to

assess baseline incidence of this important factor in stress and test performance research. Hopefully, these alterations would help to improve and strengthen the study, and help to further elucidate the connection between the presence of a stressor and its effects on tests of attention and memory.

**Table 1**

Exclusion Criteria for Subject Selection

1. Regular (eg., weekly) use of recreational drugs.

2. History of alcohol abuse or dependence.

3. Current presence of depression.

4. History of significant head injury, including serious concussion with or without loss of consciousness, and skull fractures.

5. Other central nervous system complications, including meningitis, encephalitis, toxoplasmosis, treatment for stroke, multiple sclerosis, previous brain surgery.

6. Visual impairments, and learning and/or reading disorders, including dyslexia.

7. Current psychoactive medications which cannot be stopped before and during experimental session, including: antipsychotics, antidepressants, anxiolytics, sedatives, muscle relaxants, sleep aids, narcotics.

8. Current smoking of cigarettes.

**Table 2**

Mean scores from the Tension-Anxiety subscale of the Profile of Moods Scale. (Note: increasing scores indicate increasing levels of tension-anxiety.)

| | POMS #1 | POMS #2 | POMS #3 |
|---|---|---|---|
| No Stress - No Distraction | 7.28 | 6.44 | 5.22 |
| No Stress - Distraction | 7.47 | 5.82 | 5.12 |
| Stress - No Distraction | 5.06 | 7.41 | 8.65 |
| Stress - Distraction | 5.29 | 4.18 | 4.53 |

**Table 3a**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Score), Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .004 | .60 |
| Number Life Events -- Past Six Months | .043 | .09 |
| Total Life Events Adjustment Score | .005 | .54 |
| Total Number of Life Events | .036 | .12 |

**Table 3b**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Scale Score)
Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}=$ |
|---|---|---|
| Perceived Stress | <.001 | .80 |
| Number Life Events -- Past Six Months | .079 | .02 |
| Total Life Events Adjustment Score | .003 | .66 |
| Total Number of Life Events | .033 | .13 |

**Table 3c**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Score), Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Perceived Stress | .003 | .65 |
| Number Life Events -- Past Six Months | .026 | .18 |
| Total Life Events Adjustment Score | .047 | .07 |
| Total Number of Life Events | .066 | .03 |

**Table 3d**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Scale Score)
Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | <.001 | .93 |
| Number Life Events -- Past Six Months | .062 | .04 |
| Total Life Events Adjustment Score | .030 | .15 |
| Total Number of Life Events | .077 | .02 |

**Table 3e**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Time), Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | .010 | .41 |
| Number Life Events -- Past Six Months | .001 | .79 |
| Total Life Events Adjustment Score | .038 | .11 |
| Total Number of Life Events | .041 | .09 |

**Table 3f**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Hits), Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Perceived Stress | .001 | .78 |
| Number Life Events -- Past Six Months | .013 | .35 |
| Total Life Events Adjustment Score | .102 | .01 |
| Total Number of Life Events | .011 | .37 |

**Table 3g**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Time), Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .014 | .34 |
| Number Life Events -- Past Six Months | .073 | .02 |
| Total Life Events Adjustment Score | <.001 | .88 |
| Total Number of Life Events | .064 | .03 |

**Table 3h**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Errors), Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | .047 | .07 |
| Number Life Events -- Past Six Months | .037 | .10 |
| Total Life Events Adjustment Score | .009 | .41 |
| Total Number of Life Events | .001 | .79 |

**Table 3i**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails B (Time), Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .009 | .44 |
| Number Life Events -- Past Six Months | .001 | .76 |
| Total Life Events Adjustment Score | .030 | .15 |
| Total Number of Life Events | .082 | .02 |

**Table 3j**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails B (Errors), Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .003 | .66 |
| Number Life Events -- Past Six Months | <.001 | .91 |
| Total Life Events Adjustment Score | .012 | .37 |
| Total Number of Life Events | .003 | .66 |

**Table 3k**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 1, Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | .012 | .37 |
| Number Life Events -- Past Six Months | .049 | .07 |
| Total Life Events Adjustment Score | .041 | .09 |
| Total Number of Life Events | .084 | .01 |

**Table 31**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 2, Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | .020 | .24 |
| Number Life Events -- Past Six Months | .089 | .01 |
| Total Life Events Adjustment Score | .038 | .09 |
| Total Number of Life Events | .087 | .01 |

**Table 3m**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 3, Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Perceived Stress | .004 | .59 |
| Number Life Events -- Past Six Months | .082 | .02 |
| Total Life Events Adjustment Score | .023 | .20 |
| Total Number of Life Events | .059 | .03 |

**Table 3n**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 4, Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .011 | .38 |
| Number Life Events -- Past Six Months | .095 | .01 |
| Total Life Events Adjustment Score | .023 | .19 |
| Total Number of Life Events | .071 | .02 |

**Table 3o**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 5, Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Perceived Stress | .011 | .39 |
| Number Life Events -- Past Six Months | .118 | .01 |
| Total Life Events Adjustment Score | .013 | .33 |
| Total Number of Life Events | .068 | .02 |

**Table 3p**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT B, Time 1

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Perceived Stress | .002 | .71 |
| Number Life Events -- Past Six Months | .091 | .01 |
| Total Life Events Adjustment Score | .043 | .08 |
| Total Number of Life Events | .011 | .36 |

**Table 4a**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Score), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .184 | .00 |
| Perceived Stress | <.001 | .82 |
| Number Life Events -- Past Six Months | .002 | .68 |
| Total Life Events Adjustment Score | <.001 | .95 |
| Total Number of Life Events | .001 | .77 |

**Table 4b**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Scale Score), Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}=$ |
|---|---|---|
| Baseline Digit Span | .268 | .00 |
| Perceived Stress | .001 | .74 |
| Number Life Events -- Past Six Months | <.001 | .94 |
| Total Life Events Adjustment Score | .002 | .66 |
| Total Number of Life Events | .008 | .41 |

**Table 4c**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Score), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .334 | .00 |
| Perceived Stress | <.001 | .88 |
| Number Life Events -- Past Six Months | .016 | .21 |
| Total Life Events Adjustment Score | .005 | .49 |
| Total Number of Life Events | .002 | .70 |

**Table 4d**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Scale Score), Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Baseline Digit Span | .355 | .00 |
| Perceived Stress | .003 | .59 |
| Number Life Events -- Past Six Months | <.001 | .90 |
| Total Life Events Adjustment Score | .007 | .41 |
| Total Number of Life Events | .002 | .63 |

**Table 4e**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Baseline Cancellation | .031 | .14 |
| Perceived Stress | .019 | .25 |
| Number Life Events -- Past Six Months | .024 | .20 |
| Total Life Events Adjustment Score | .026 | .18 |
| Total Number of Life Events | .053 | .05 |

**Table 4f**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Cancellation | -- | -- |
| Perceived Stress | .016 | .30 |
| Number Life Events -- Past Six Months | .042 | .09 |
| Total Life Events Adjustment Score | .023 | .20 |
| Total Number of Life Events | .055 | .05 |

**Table 4g**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails A | .258 | .00 |
| Perceived Stress | .014 | .25 |
| Number Life Events -- Past Six Months | .019 | .19 |
| Total Life Events Adjustment Score | <.001 | .83 |
| Total Number of Life Events | .003 | .61 |

**Table 4h**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails A | .019 | .25 |
| Perceived Stress | .000 | .99 |
| Number Life Events -- Past Six Months | .068 | .03 |
| Total Life Events Adjustment Score | <.001 | .85 |
| Total Number of Life Events | .006 | .51 |

**Table 4i**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails B (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails B | .376 | .00 |
| Perceived Stress | .001 | .69 |
| Number Life Events -- Past Six Months | .065 | .01 |
| Total Life Events Adjustment Score | <.001 | .76 |
| Total Number of Life Events | .007 | .38 |

**Table 4j**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails B (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails B | .055 | .05 |
| Perceived Stress | .017 | .27 |
| Number Life Events -- Past Six Months | .025 | .18 |
| Total Life Events Adjustment Score | .005 | .55 |
| Total Number of Life Events | .014 | .31 |

**Table 4k**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 1, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 1 | .935 | .00 |
| Perceived Stress | .001 | .25 |
| Number Life Events -- Past Six Months | <.001 | .63 |
| Total Life Events Adjustment Score | .003 | .07 |
| Total Number of Life Events | <.001 | .66 |

**Table 41**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 2, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 2 | .008 | .47 |
| Perceived Stress | .001 | .78 |
| Number Life Events -- Past Six Months | .023 | .22 |
| Total Life Events Adjustment Score | <.001 | .87 |
| Total Number of Life Events | .014 | .34 |

**Table 4m**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 3, Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Baseline AVLT 3 | .676 | .00 |
| Perceived Stress | .002 | .51 |
| Number Life Events -- Past Six Months | .017 | .06 |
| Total Life Events Adjustment Score | .001 | .60 |
| Total Number of Life Events | .023 | .03 |

**Table 4n**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 4, Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}=$ |
|---|---|---|
| Baseline AVLT 4 | .829 | .00 |
| Perceived Stress | <.001 | .56 |
| Number Life Events -- Past Six Months | .007 | .10 |
| Total Life Events Adjustment Score | <.001 | .93 |
| Total Number of Life Events | .006 | .14 |

**Table 4o**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 5, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 5 | .819 | .00 |
| Perceived Stress | <.001 | .95 |
| Number Life Events -- Past Six Months | <.001 | .77 |
| Total Life Events Adjustment Score | <.001 | .76 |
| Total Number of Life Events | .006 | .13 |

**Table 4p**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent Variable: AVLT B, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT B | .260 | .00 |
| Perceived Stress | .003 | .61 |
| Number Life Events -- Past Six Months | .032 | .09 |
| Total Life Events Adjustment Score | .030 | .10 |
| Total Number of Life Events | .015 | .23 |

**Table 5a**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Number), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .184 | .00 |
| Distraction | .006 | .47 |
| Stress | <.001 | .90 |
| Dist x Stress Interaction | <.001 | .88 |
| Sex | .007 | .44 |

Dependent Variable: Digit Span (Forward, Number), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .278 | .00 |
| Distraction | .006 | .47 |
| Stress | <.001 | .90 |
| Dist x Stress Interaction | <.001 | .88 |
| Sex | .007 | .44 |

**Table 5b**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Forward, Scale Score), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .268 | .00 |
| Distraction | .005 | .49 |
| Stress | .000 | .99 |
| Dist x Stress Interaction | <.001 | .98 |
| Sex | <.001 | .82 |

Dependent Variable: Digit Span (Forward, Scale Score), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .153 | .00 |
| Distraction | .006 | .49 |
| Stress | .000 | .99 |
| Dist x Stress Interaction | <.001 | .98 |
| Sex | <.001 | .82 |

**Table 5c**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Number), Time 2

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Digit Span | .335 | .00 |
| Distraction | .010 | .31 |
| Stress | <.001 | .89 |
| Dist x Stress Interaction | .033 | .07 |
| Sex | .029 | .08 |

Dependent Variable: Digit Span (Backward, Number), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Digit Span | .288 | .00 |
| Distraction | .011 | .31 |
| Stress | <.001 | .89 |
| Dist x Stress Interaction | .035 | .07 |
| Sex | .031 | .08 |

**Table 5d**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Digit Span (Backward, Scale Score), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .355 | .00 |
| Distraction | <.001 | .97 |
| Stress | .004 | .53 |
| Dist x Stress Interaction | .009 | .32 |
| Sex | .025 | .11 |

Dependent Variable: Digit Span (Backward, Scale Score) Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Digit Span | .179 | .00 |
| Distraction | <.001 | .97 |
| Stress | .005 | .53 |
| Dist x Stress Interaction | .012 | .32 |
| Sex | .031 | .11 |

**Table 5e**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $\underline{p}$= |
|---|---|---|
| Baseline Trails A | .258 | .00 |
| Distraction | <.001 | .84 |
| Stress | <.001 | .88 |
| Dist x Stress Interaction | <.001 | .89 |
| Sex | .021 | .17 |

Dependent Variable: Trails A (Time), Time 2 - Time 1

Dist x Stress
Interaction <.001 .89

Sex .021 .17

**Table 5f**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails A (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails A | .019 | .24 |
| Distraction | <.001 | .86 |
| Stress | .014 | .33 |
| Dist x Stress Interaction | .002 | .74 |
| Sex | .001 | .78 |

Dependent Variable: Trails A (Errors), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails A | .768 | .00 |
| Distraction | <.001 | .86 |
| Stress | .003 | .33 |
| Dist x Stress Interaction | <.001 | .74 |
| Sex | <.001 | .78 |

**Table 5g**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trails B (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails B | .376 | .00 |
| Distraction | .007 | .37 |
| Stress | .006 | .41 |
| Dist x Stress Interaction | <.001 | .85 |
| Sex | .072 | .01 |

Dependent Variable: Trails B (Time), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline | .338 | .00 |
| Distraction | .008 | .37 |
| Stress | .007 | .41 |
| Dist x Stress Interaction | <.001 | .85 |
| Sex | .076 | .01 |

**Table 5h**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Trailes B (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails B | .055 | .05 |
| Distraction | .018 | .25 |
| Stress | .044 | .07 |
| Dist x Stress Interaction | .055 | .04 |
| Sex | .013 | .32 |

Dependent Variable: Trails B (Errors), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Trails B | .268 | .00 |
| Distraction | .014 | .25 |
| Stress | .034 | .07 |
| Dist x Stress Interaction | .043 | .04 |
| Sex | .010 | .32 |

**Table 5i**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Time), Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Cancel. | .031 | .14 |
| Distraction | .019 | .25 |
| Stress | .012 | .36 |
| Dist x Stress Interaction | .030 | .14 |
| Sex | .010 | .39 |

Dependent Variable: Cancellation (Time), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline Cancel. | .041 | .09 |
| Distraction | .019 | .25 |
| Stress | .012 | .36 |
| Dist x Stress Interaction | .030 | .14 |
| Sex | .010 | .39 |

**Table 5j**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Errors), Time 2

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Cancel. | -- | -- |
| Distraction | .014 | .32 |
| Stress | .014 | .32 |
| Dist x Stress Interaction | .014 | .32 |
| Sex | .014 | .32 |

Dependent Variable: Cancellation (Errors), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Cancel. | -- | -- |
| Distraction | .014 | .32 |
| Stress | .014 | .32 |
| Dist x Stress Interaction | .014 | .32 |
| Sex | .014 | .32 |

**Table 5k**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: Cancellation (Hits), Time 2

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Cancel. | .030 | .15 |
| Distraction | .004 | .59 |
| Stress | .023 | .20 |
| Dist x Stress Interaction | .004 | .59 |
| Sex | .015 | .31 |

Dependent Variable: Cancellation (Hits), Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p$= |
|---|---|---|
| Baseline Cancel. | <.001 | .87 |
| Distraction | .004 | .59 |
| Stress | .024 | .20 |
| Dist x Stress Interaction | .004 | .59 |
| Sex | .015 | .31 |

**Table 51**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 1, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 1 | .935 | .00 |
| Distraction | <.001 | .87 |
| Stress | .000 | .96 |
| Dist x Stress Interaction | <.001 | .61 |
| Sex | .002 | .16 |

Dependent Variable: AVLT 1, Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 1 | .019 | .25 |
| Distraction | <.001 | .87 |
| Stress | <.001 | .96 |
| Dist x Stress Interaction | .004 | .61 |
| Sex | .030 | .16 |

**Table 5m**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 2, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 2 | .008 | .46 |
| Distraction | .024 | .19 |
| Stress | .002 | .70 |
| Dist x Stress Interaction | .003 | .66 |
| Sex | .003 | .68 |

Dependent Variable: AVLT 2, Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 2 | .687 | .00 |
| Distraction | .008 | .19 |
| Stress | <.001 | .70 |
| Dist x Stress Interaction | <.001 | .66 |
| Sex | <.001 | .68 |

**Table 5n**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 3, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 3 | .676 | .00 |
| Distraction | <.001 | .85 |
| Stress | .004 | .34 |
| Dist x Stress Interaction | .002 | .50 |
| Sex | .000 | .99 |

Dependent Variable: AVLT 3, Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 3 | .339 | .00 |
| Distraction | <.001 | .85 |
| Stress | .009 | .34 |
| Dist x Stress Interaction | .005 | .50 |
| Sex | .000 | .99 |

**Table 5o**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 4, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 4 | .829 | .00 |
| Distraction | .000 | .97 |
| Stress | .002 | .34 |
| Dist x Stress Interaction | .000 | .99 |
| Sex | .001 | .53 |

Dependent Variable: AVLT 4, Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 4 | .361 | .00 |
| Distraction | <.001 | .97 |
| Stress | .009 | .34 |
| Dist x Stress Interaction | .000 | .99 |
| Sex | .004 | .53 |

**Table 5p**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT 5, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 5 | .819 | .00 |
| Distraction | <.001 | .93 |
| Stress | .016 | .01 |
| Dist x Stress Interaction | <.001 | .63 |
| Sex | .001 | .45 |

Dependent Variable: AVLT 5, Time 2 - TIme 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT 5 | .009 | .42 |
| Distraction | <.001 | .93 |
| Stress | .087 | .01 |
| Dist x Stress Interaction | .003 | .63 |
| Sex | .008 | .45 |

**Table 5q**

Proportion of variance for each independent variable (IV), listed in order of multiple regression entry.

Dependent variable: AVLT B, Time 2

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT A | .260 | .00 |
| Distraction | .003 | .61 |
| Stress | .001 | .74 |
| Dist x Stress Interaction | .016 | .22 |
| Sex | .035 | .07 |

Dependent Variable: AVLT B, Time 2 - Time 1

| I.V. | Change in $R^2$ | Significance level $p=$ |
|---|---|---|
| Baseline AVLT A | .190 | .00 |
| Distraction | .003 | .61 |
| Stress | .001 | .74 |
| Dist x Stress Interaction | .018 | .22 |
| Sex | .038 | .07 |

Figure Caption: **1:** Timeline of the Stress-Distraction group for the experimental session.

Figure 1. Stress/Distraction Group

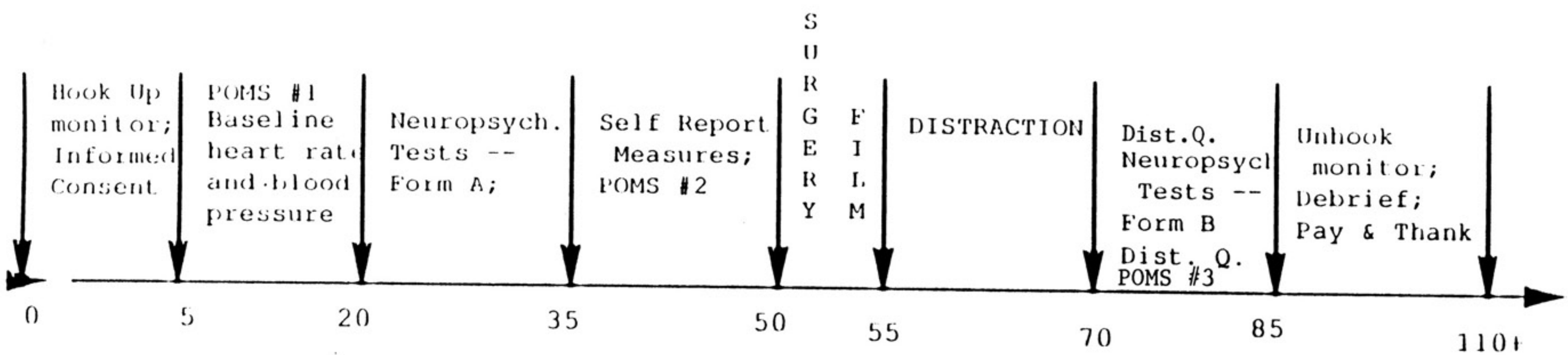


Figure Caption: **2:** Timeline of the Stress-No Distraction group for the experimental session.

Figure 2. Stress/No Distraction Group

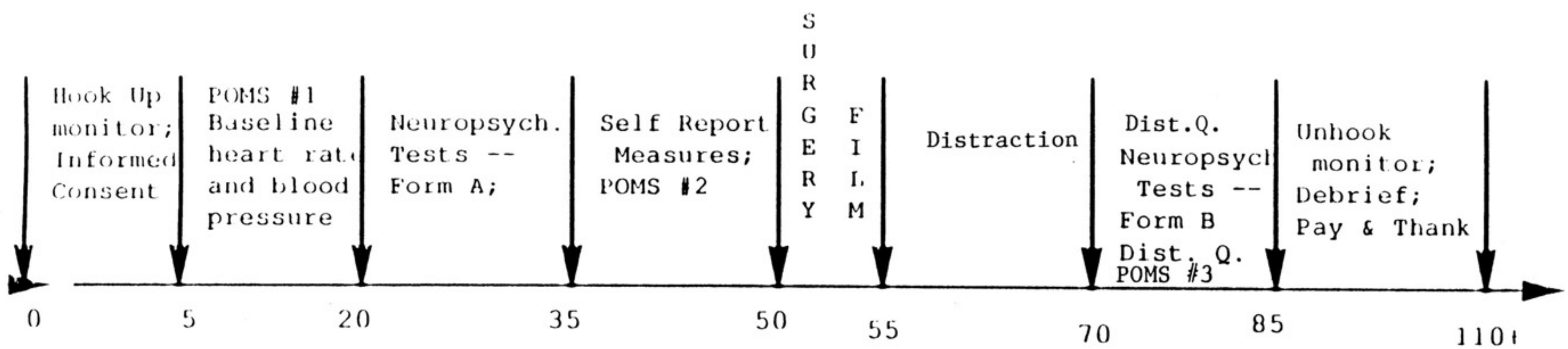


Figure Caption: **3:** Timeline of the No Stress-Distraction group for the experimental session.

Figure 3. No Stress/Distraction Group

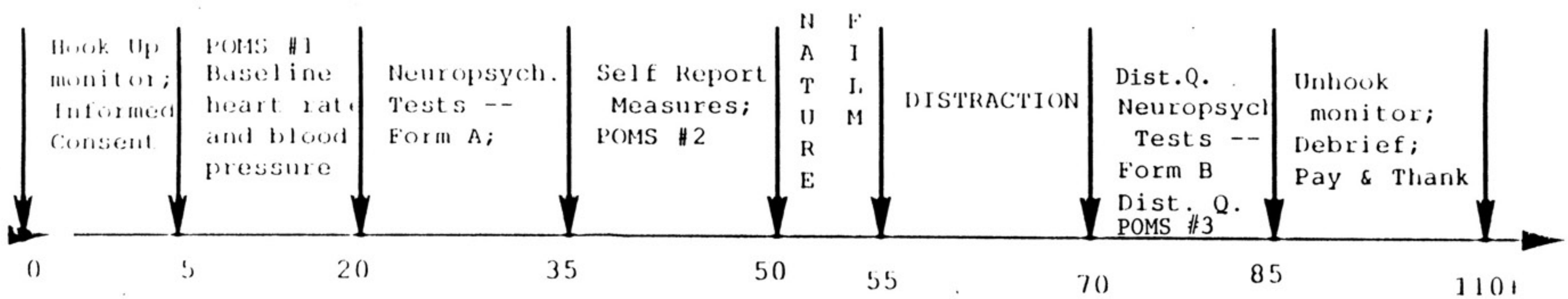


Figure Caption: **4:** Timeline of the No Stress-No Distraction group for the experimental session.

Figure 4. No Stress/No Distraction Group

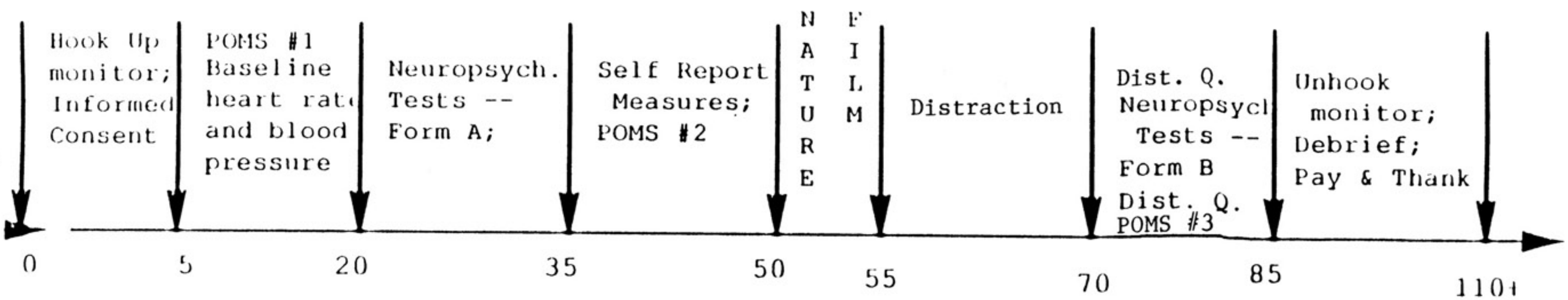
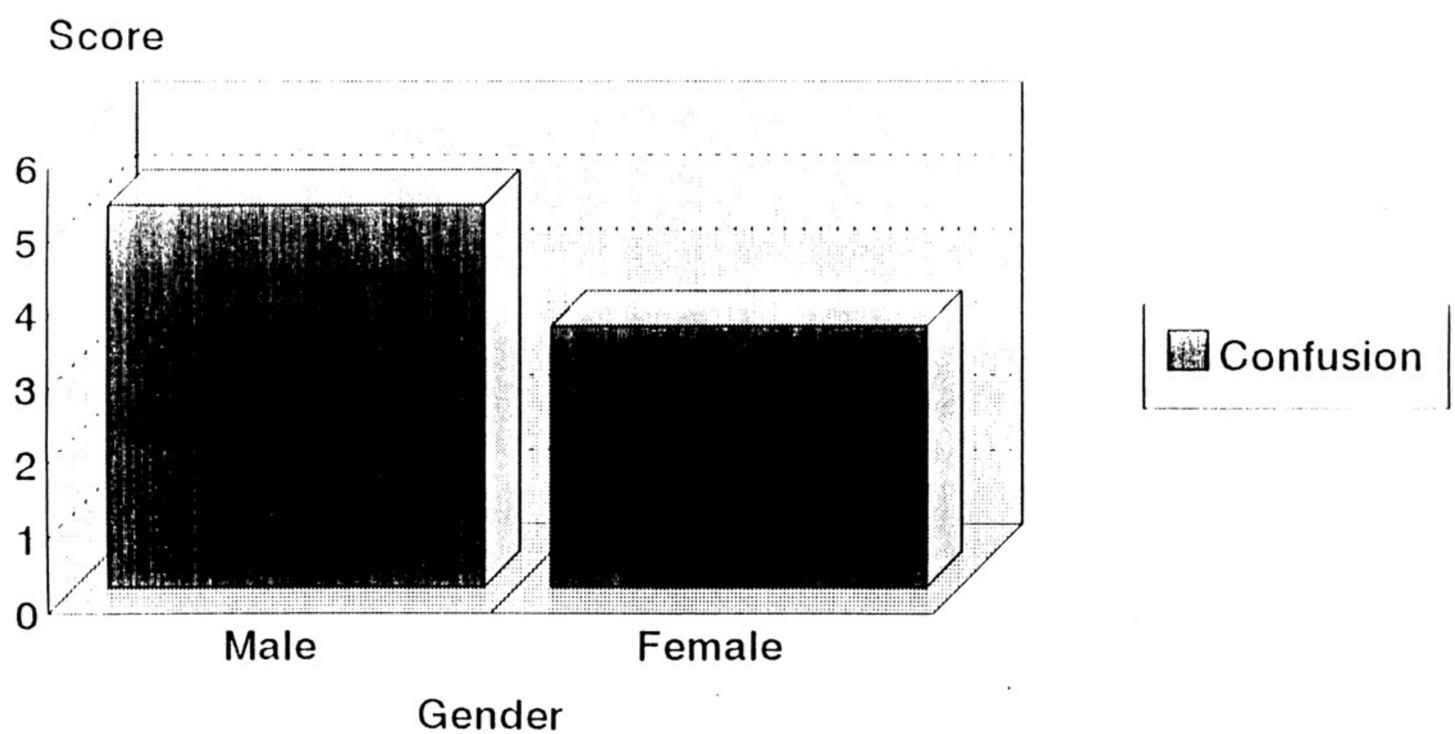


Figure Caption: **5:** Mean baseline scores from the POMS Confusion scale for males and females collapsed across the experimental conditions. ANOVA revealed a significant effect of sex, $\underline{p}<.03$.

# Figure 5
## POMS Confusion/Bewilderment
(Time 1)

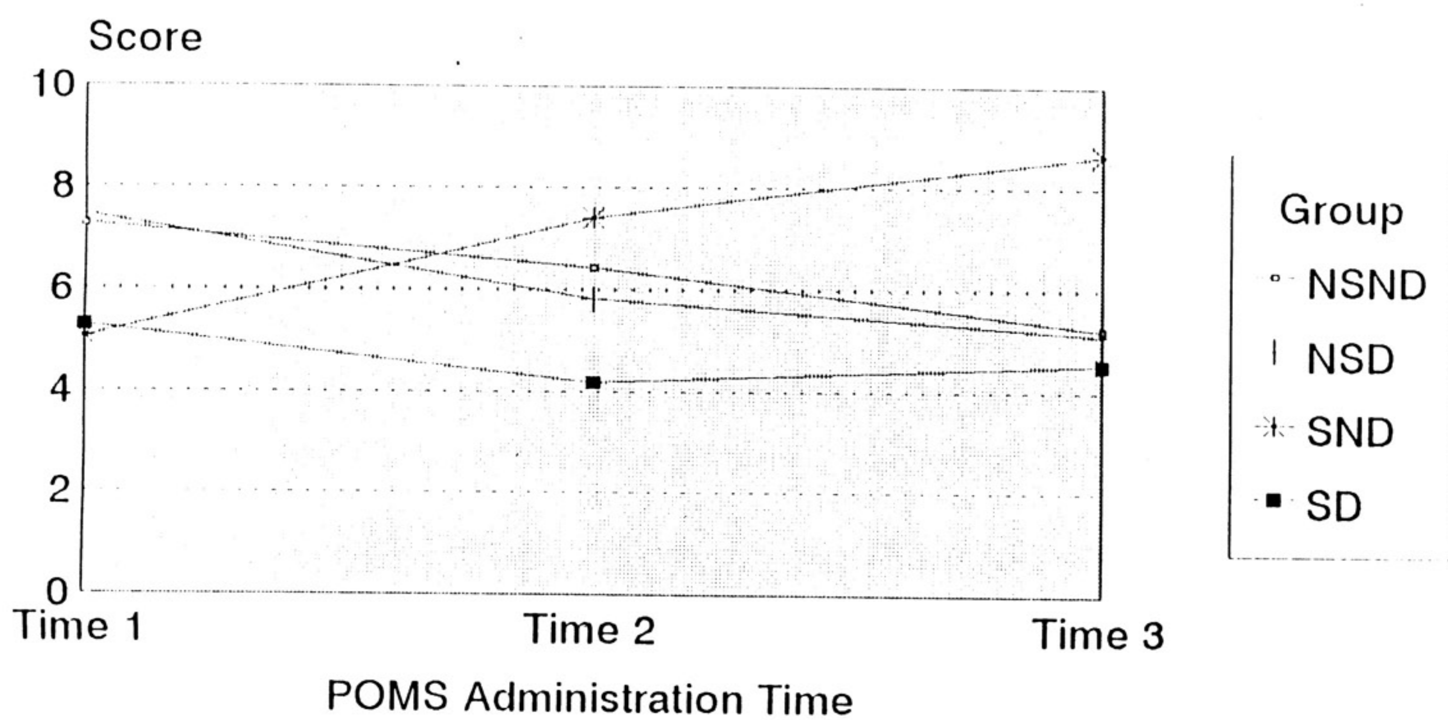



main effect of sex, $p<.03$

Figure Caption: **6:** Mean scores from the POMS Tension scale representing change from baseline for the four experimental groups (NSND=no stress, no distraction; NSD=no stress, distraction; SND=stress, no distraction; SD=stress, distraction). MANCOVA revealed a main effect of stress, $\underline{p}<.03$, a main effect of distraction, $\underline{p}<.01$, and a stress X distraction interaction, $\underline{p}<.04$. Tukey *post hocs* revealed that the stress-no distraction condition reported significantly more tension than the stress-distraction condition.

# Figure 6

POMS Tension/Anxiety

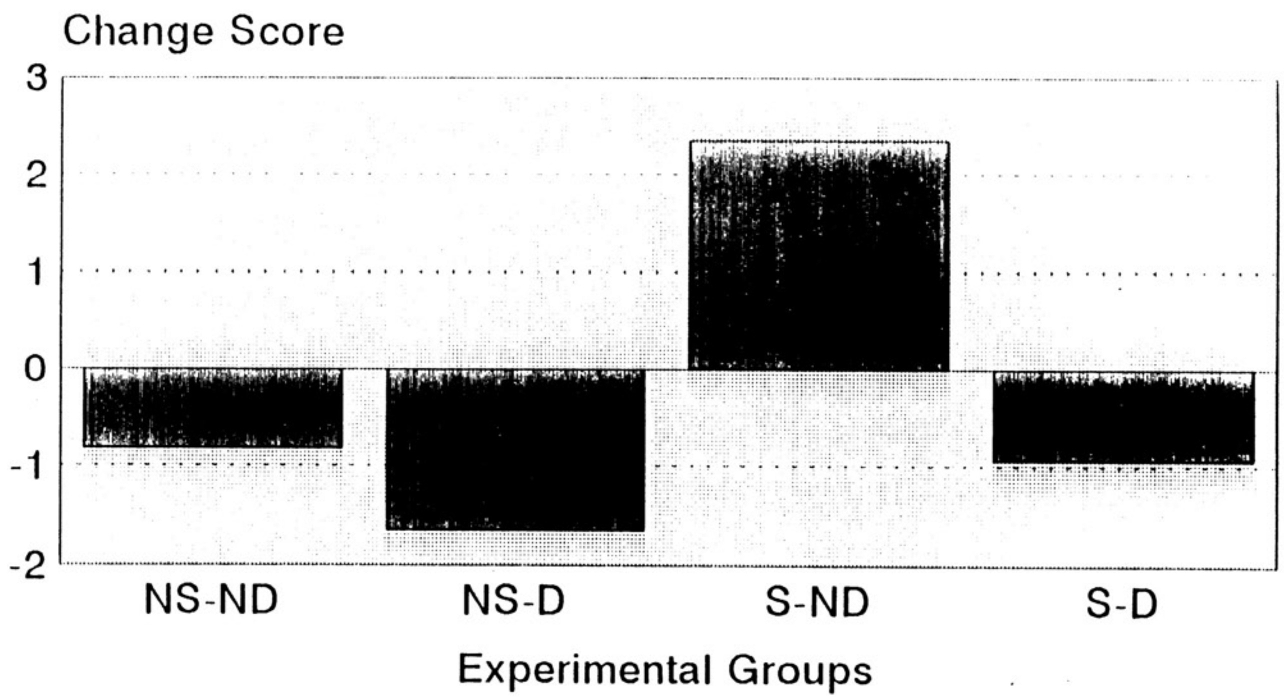



main effect of stress, $p<.03$
main effect of distraction, $p<.01$
stress X distraction interaction, $p<.04$

Figure Caption: **7:** Mean change scores from the POMS Tension scale representing the change between the second (pre-film) and first (baseline) POMS administrations for the four experimental groups. MANCOVA revealed a main effect of stress, and a main effect of distraction, $\underline{p}$s<.03.

# Figure 7

POMS Tension/Anxiety
Change Score (T2-T1)

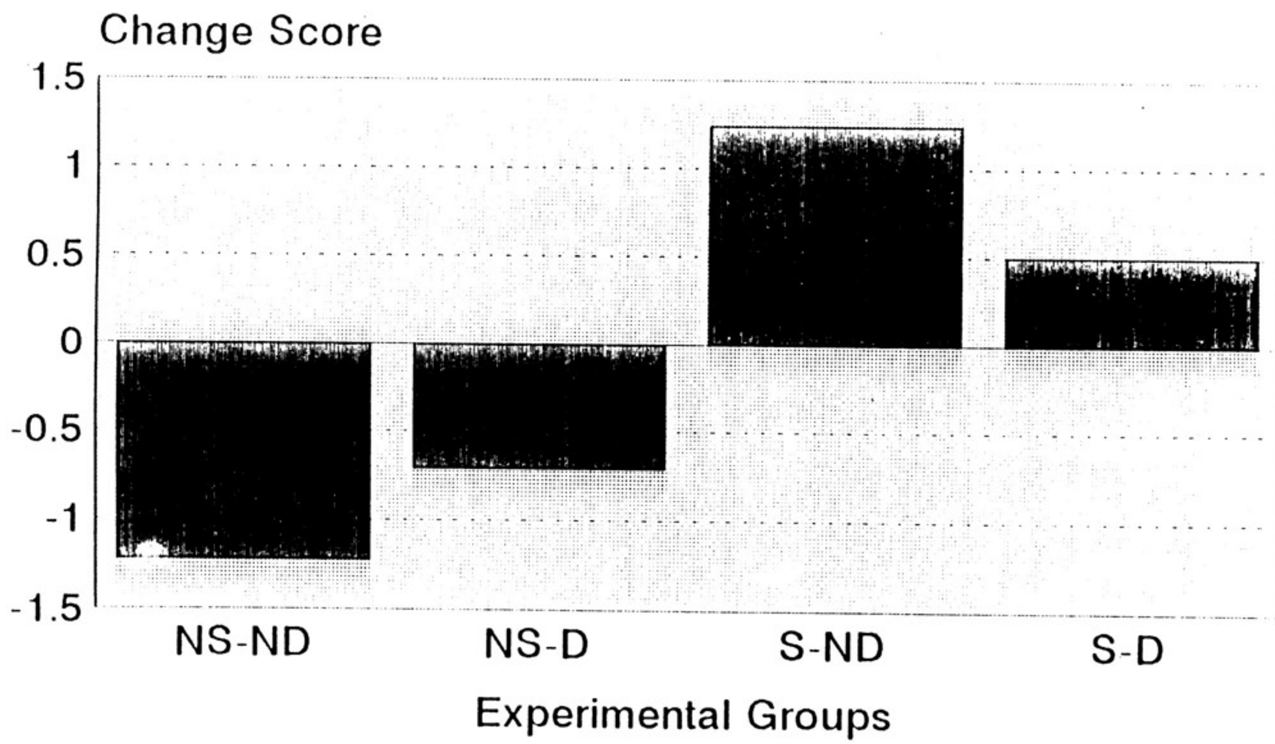



main effect of stress, $p<.03$
main effect of distraction, $p<.03$

Figure Caption: **8:** Mean change scores from the POMS Tension scale representing the change between the third (post-film) and second (pre-film) POMS administrations for the four experimental groups. MANCOVA revealed a main effect of stress, $\underline{p}<.01$.

# Figure 8

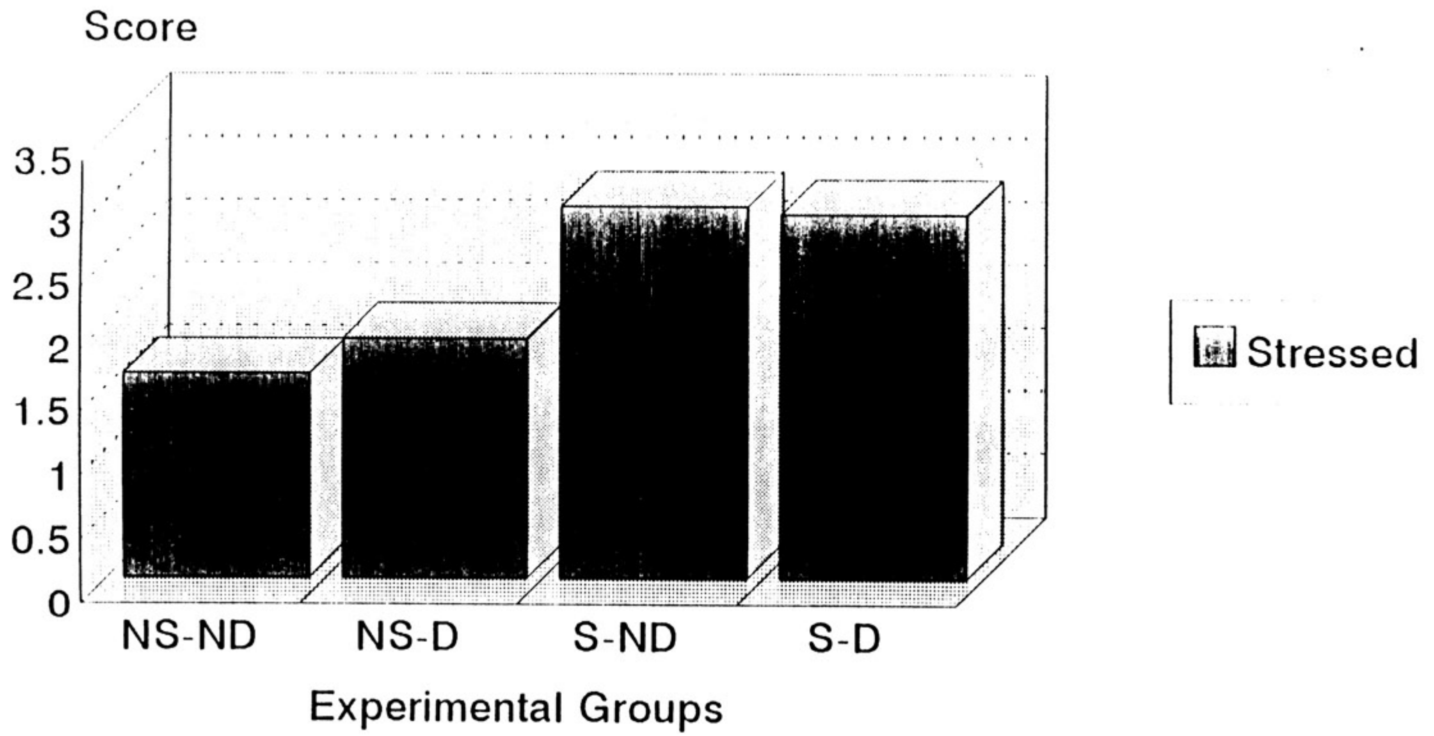
## POMS Tension/Anxiety Change Score (T3-T2)




main effect of stress, p<.01

Figure Caption: **9:** Mean baseline scores for the four experimental groups from Distraction Questionnaire item #2, which assessed how stressed the subjects reported feeling in the past 15 minutes (during the anticipatory stress/distraction period). ANOVA revealed a main effect of stress, $\underline{p}<.04$. Tukey *post hocs* showed that the no stress-no distraction condition reported feeling less stressed than the stress-no distraction condition.

# Figure 9
## DQ #2 -- Stressed
## Time 1

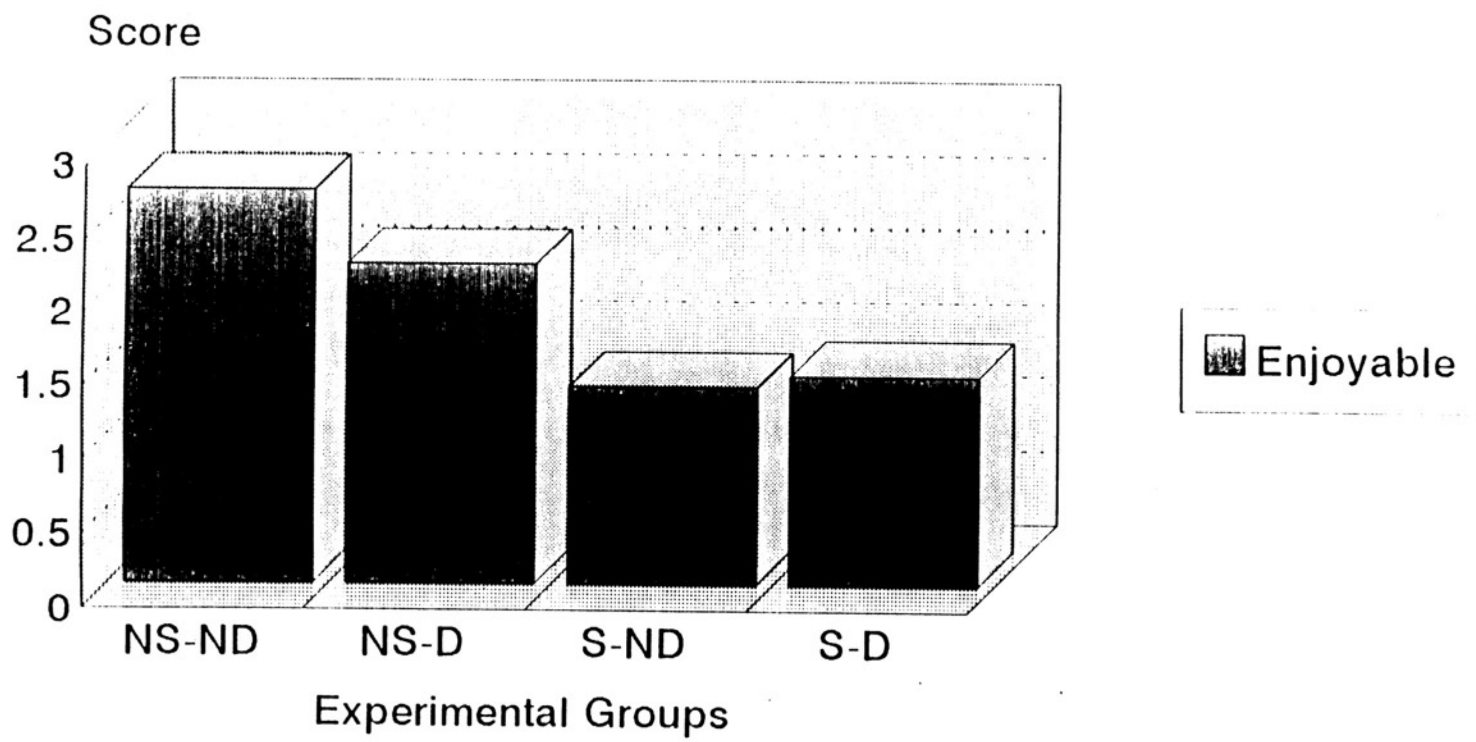



main effect of stress, $p<.04$

Figure Caption: **10:** Mean baseline scores for the four experimental groups from Distraction Questionnaire item #4, which assessed how enjoyable was the film the subjects just saw. ANOVA revealed a main effect of stress, $p<.001$. Tukey *post hocs* showed that both stress groups found the surgery film less enjoyable than the no stress groups found the travel film.

# Figure 10

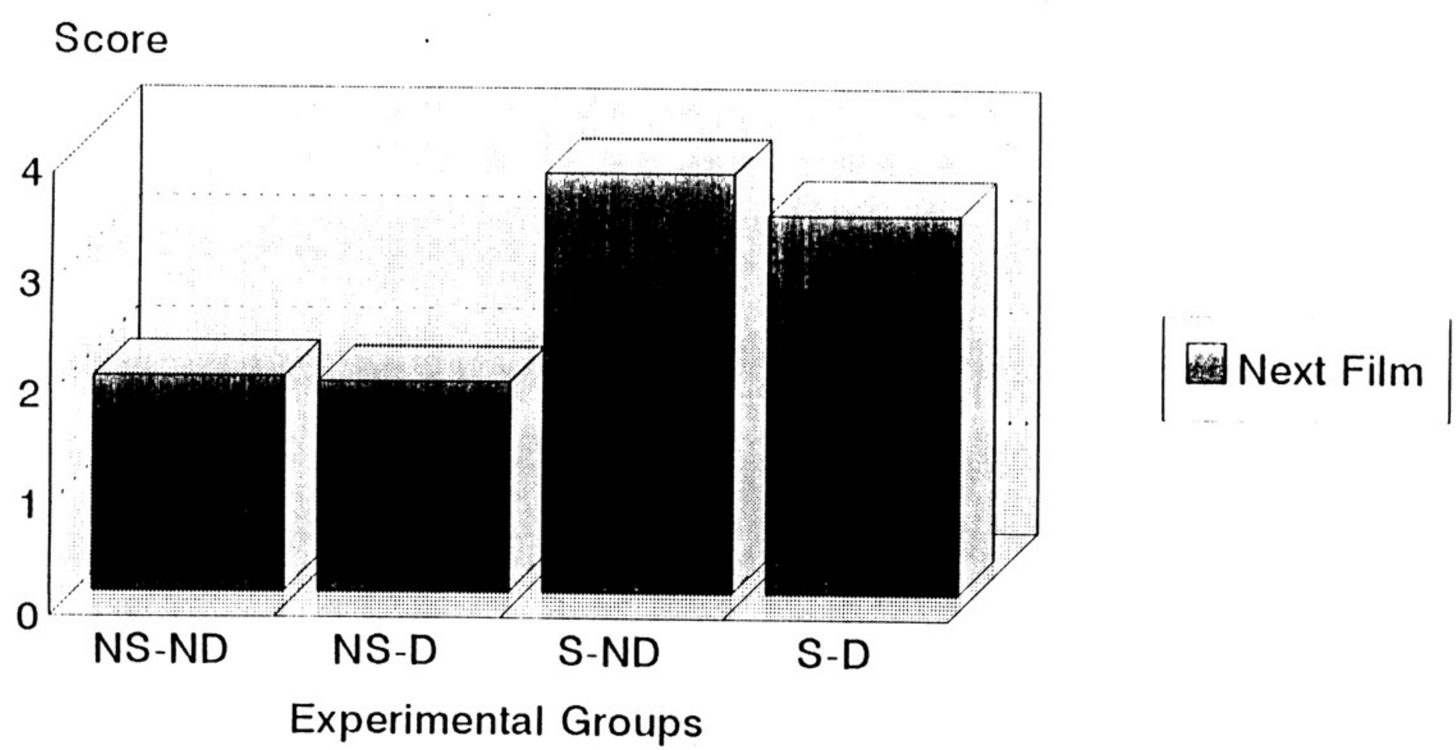
DQ #4 -- Enjoyability of film
Time 1




main effect of stress, $p<.001$

Figure Caption: **11:** Mean baseline scores for the four experimental groups from Distraction Questionnaire item #7, which assessed how stressful the next film would be. ANOVA revealed a main effect of stress, $\underline{p}<.001$. Tukey *post hocs* showed that both stress groups felt that the next film would be more stressful than the no stress groups felt the travel film would be.

# Figure 11
## DQ #7 -- Stressful/Next Film
## Time 1

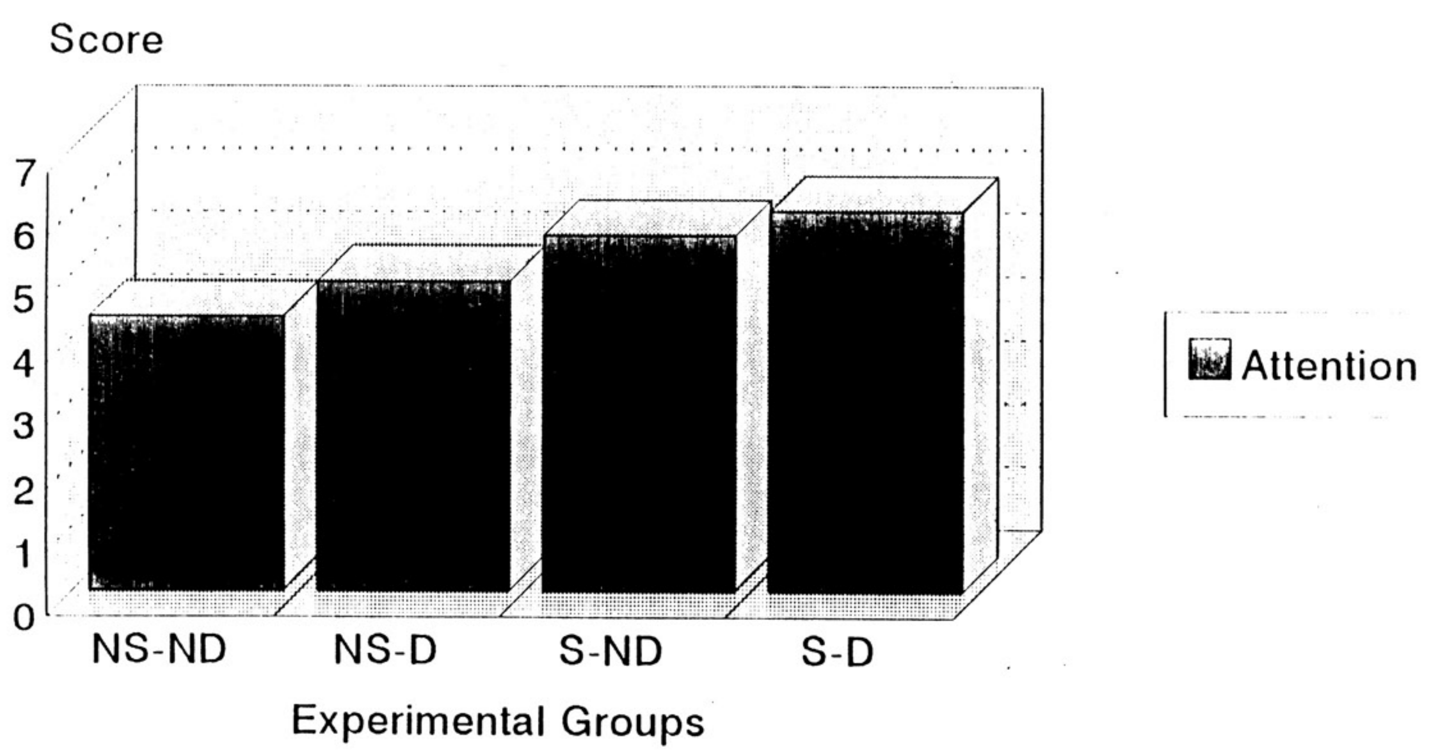



main effect of stress, p<.001

Figure Caption: **12:** Mean baseline scores for the four experimental groups from Distraction Questionnaire item #8, which assessed how much attention the subjects paid to the film. ANOVA revealed a main effect of stress, $\underline{p}<.001$. Tukey *post hocs* showed that the no stress-no distraction condition paid less attention to the travel film than both stress groups paid to their surgery film.

# Figure 12

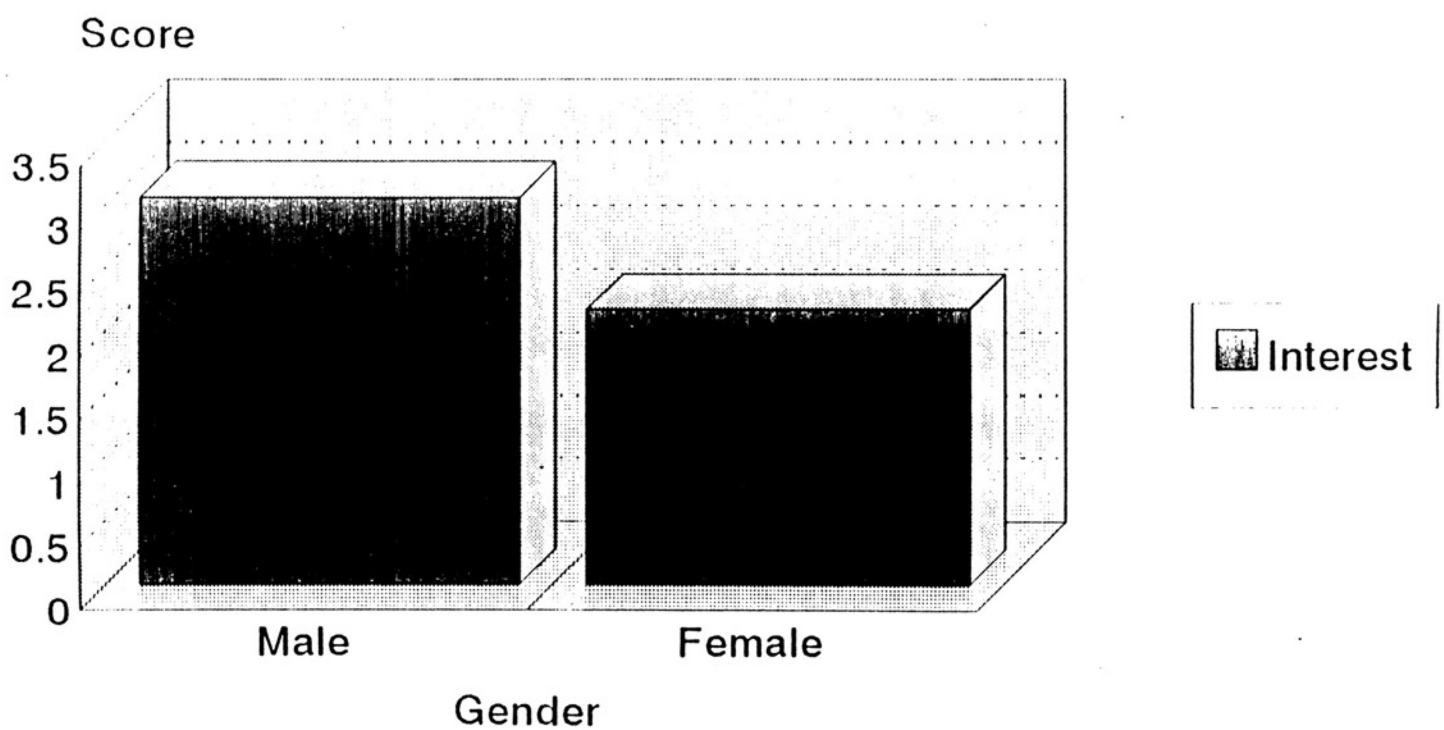
## DQ #8 - Attention
## Time 1




main effect of stress, $p < .001$

Figure Caption: **13:** Mean baseline scores for males and females collapsed across the experimental conditions from Distraction Questionnaire item #6, which assessed interest in the film. ANOVA revealed a main effect of sex, $\underline{p}<.02$.

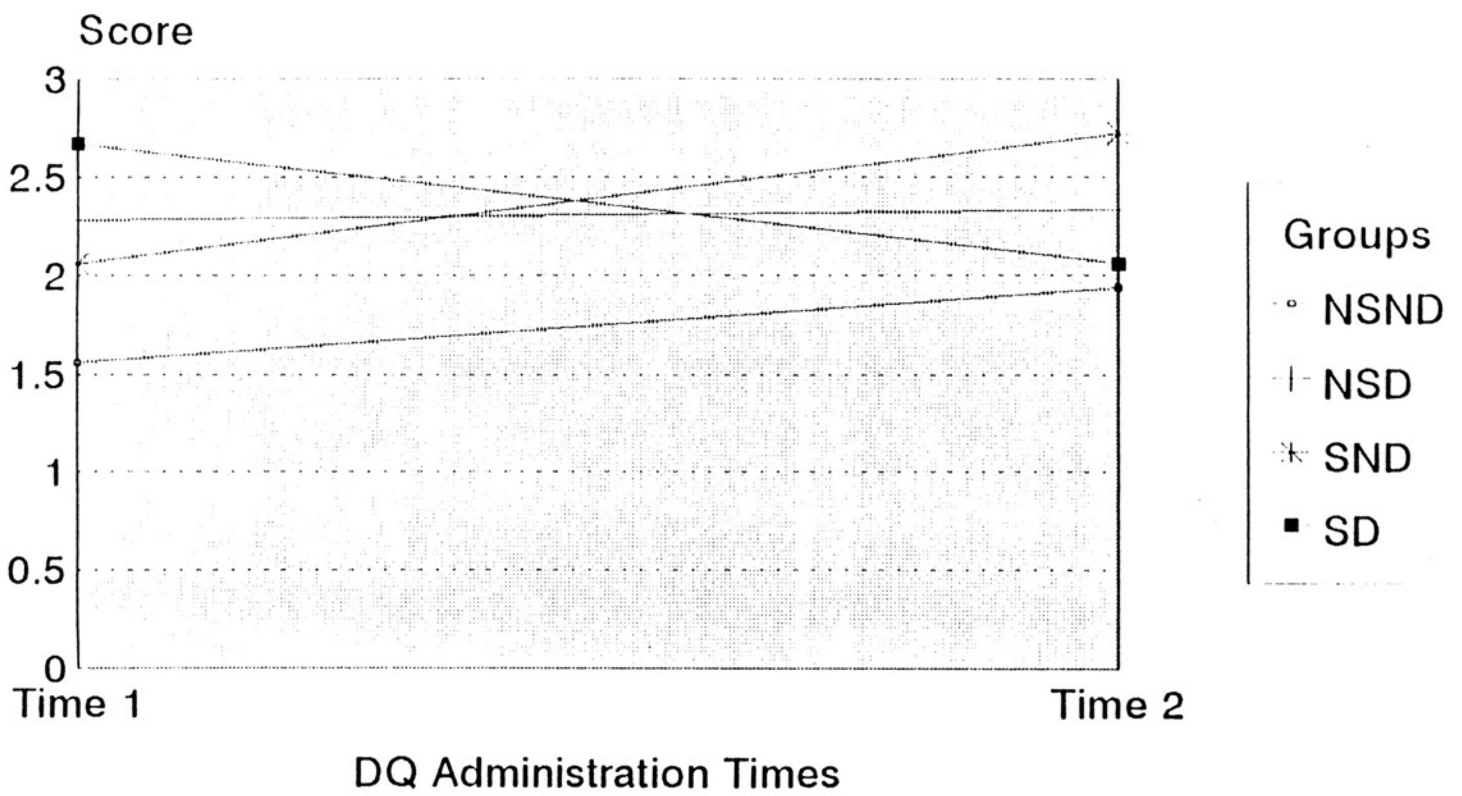
# Figure 13
## DQ #6 - Interest
## Time 1




main efect of sex, $p<.02$

Figure Caption: **14:** Mean scores representing change from baseline for the four experimental groups for Distraction Questionnaire item #3, which assessed the amount of discomfort subjects felt during the past 15 minutes. MANCOVA revealed a stress X distraction interaction, $\underline{p}<.02$.

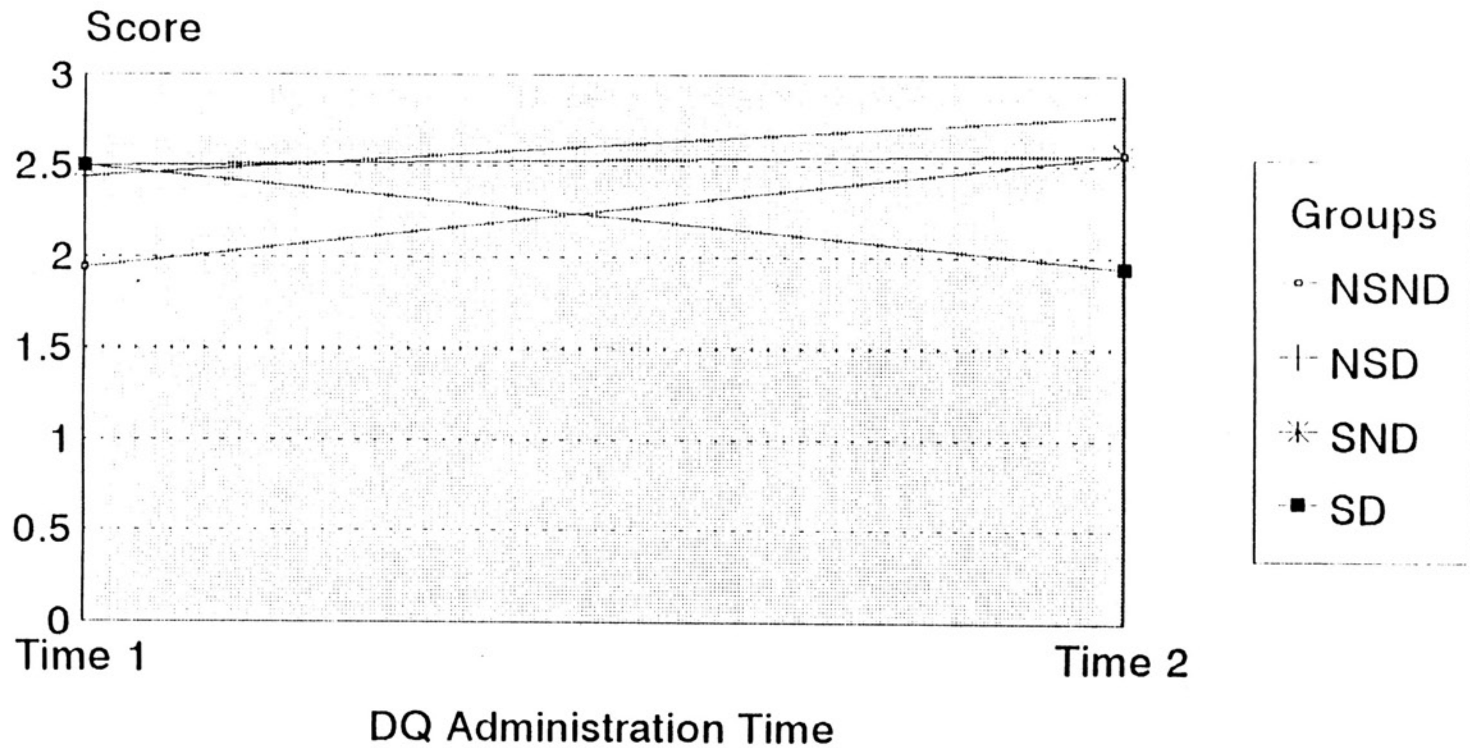
# Figure 14
## DQ #3 -- Discomfort




stress X distraction interaction, $p<.02$

Figure Caption: **15:** Mean scores representing change from baseline for the four experimental groups for Distraction Questionnaire item #5, which assessed how distracted the subjects were. MANCOVA revealed a main effect of stress, $\underline{p}<.03$, and a stress X time interaction, $\underline{p}<.02$.

# Figure 15
## DQ #5 -- Distracted

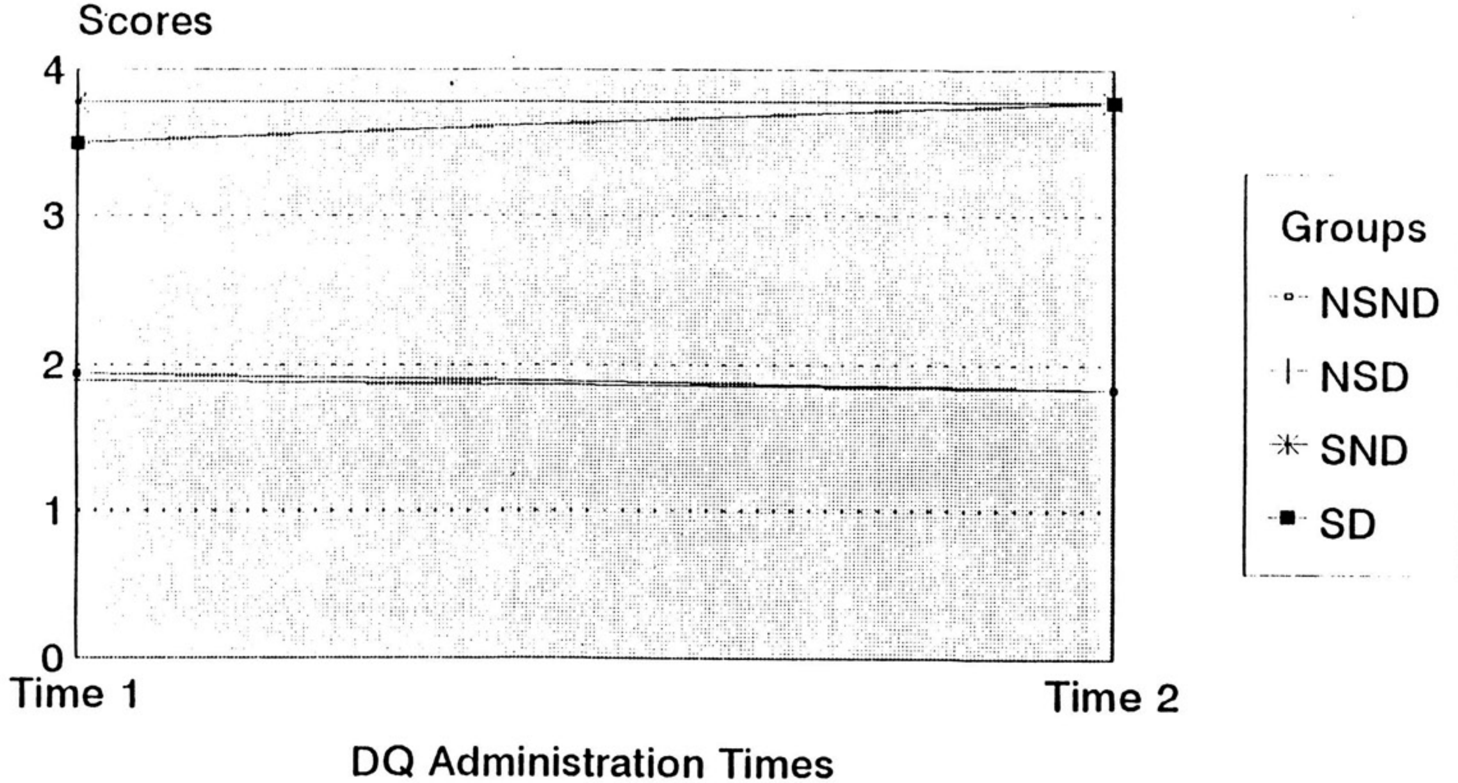



main effect of stress, $p<.03$
stress X time interaction, $p<.02$

Figure Caption: **16:** Mean scores representing change from baseline for the four experimental groups for Distraction Questionnaire item #7, which assessed how stressful the next film would be. MANCOVA revealed a main effect of stress, $p<.03$.

# Figure 16

## DQ #7 -- Next Film/Stressful

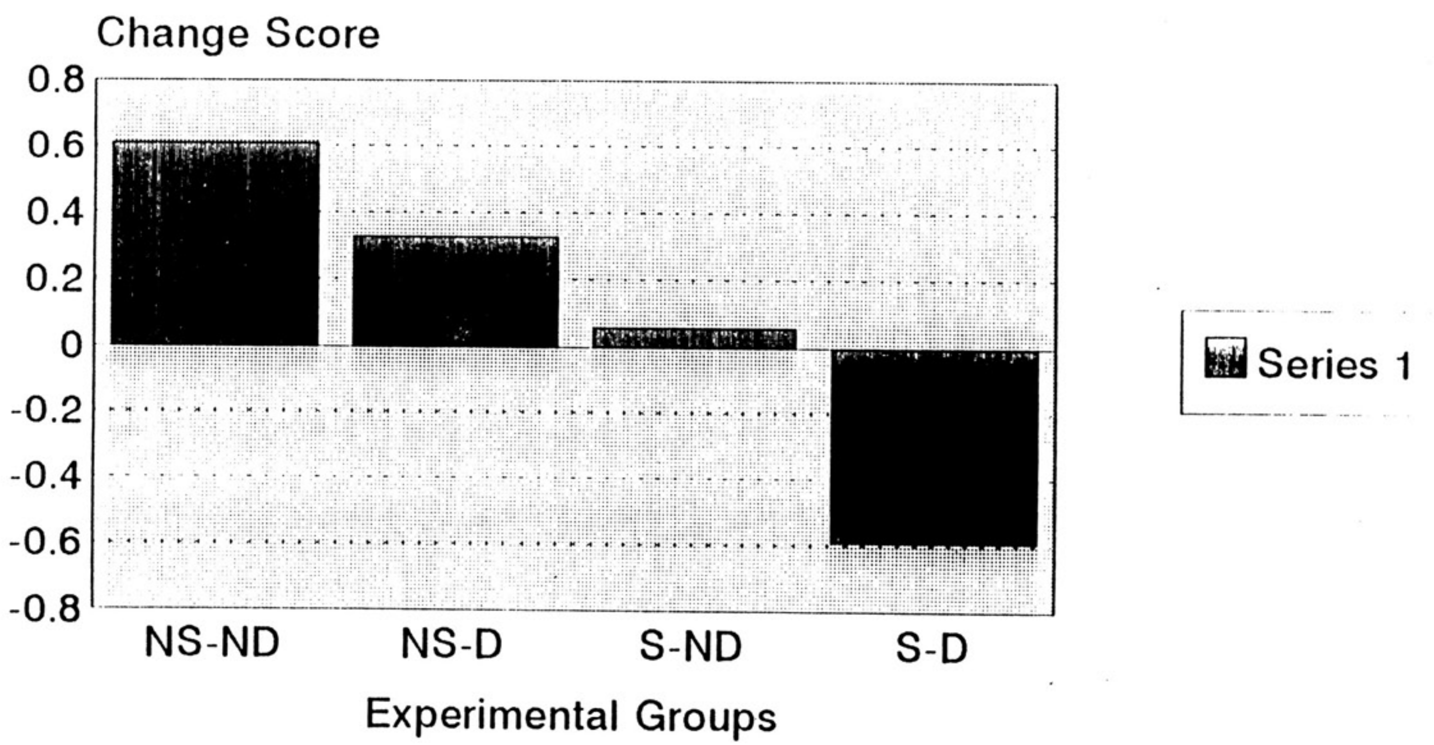



main effect of stress, $p<.03$

Figure Caption: **17:** Mean change scores for the four experimental groups representing the change from second (end of experimental session) to first (end of anticipatory stress/distraction period) administration for Distraction Questionnaire item #5, which assessed how distracted the subjects reported being. MANCOVA revealed a main effect of stress, $p<.03$. Tukey *post hocs* showed that the stress-distraction condition decreased its levels of distraction, while the no stress-no distraction condition reported an increase in distraction.

# Figure 17

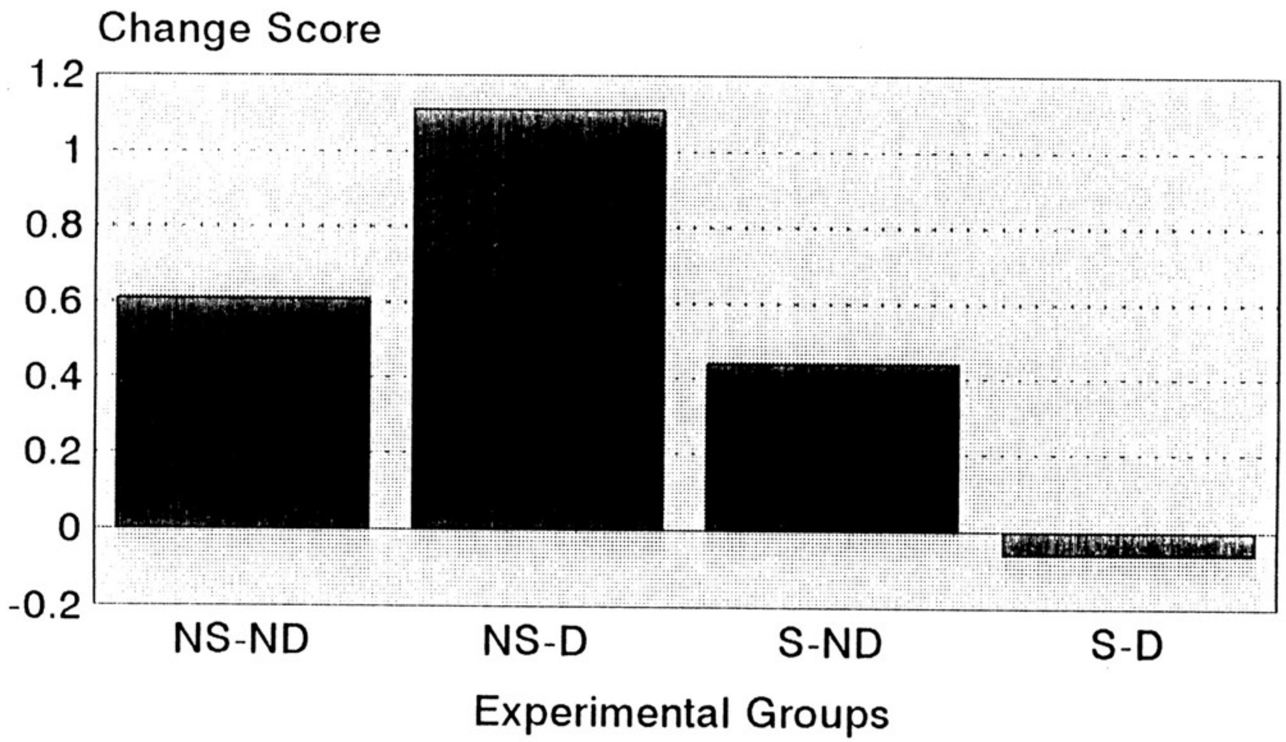
## DQ #5 - Distracted
## Change Score (T2-T1)




main effect of stress, $p<.03$

Figure Caption: **18:** Mean change scores for the four experimental groups representing change from second (end of experimental session) to first (end of anticipatory stress/distraction period) administration for Distraction Questionnaire item #2, which assessed how stress the subjects reported being. MANCOVA revealed a stress X distraction interaction, $p<.05$.

# Figure 18
## DQ #2 - Stressed
## Change Score (T2-T1)

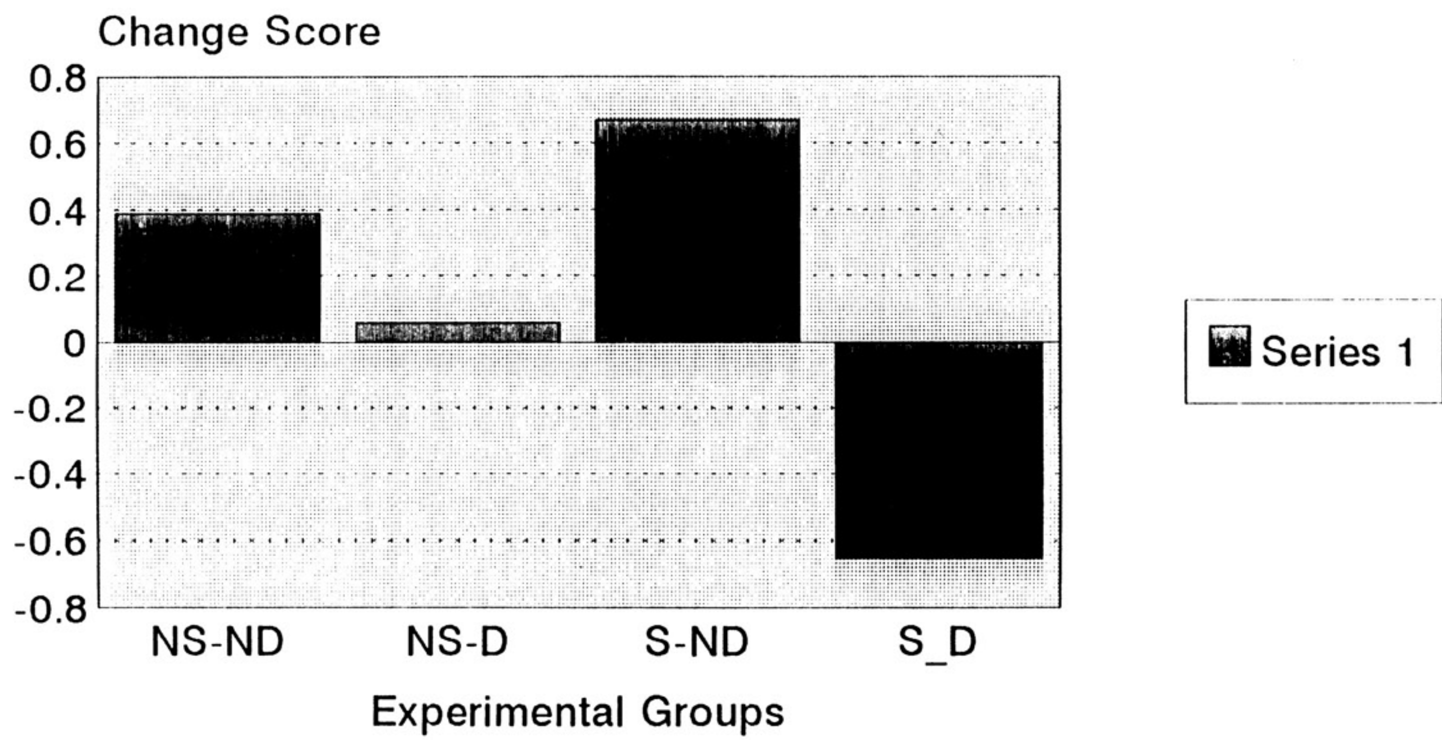



stress X distraction interaction, p<.05

Figure Caption: **19:** Mean change scores for the four experimental groups representing change from second (end of experimental session) to first (end of anticipatory stress/distraction period) administration for Distraction Questionnaire item #3, which assessed how uncomfortable the subjects were. MANCOVA revealed a stress X distraction interaction, $\underline{p}<.04$.

# Figure 19

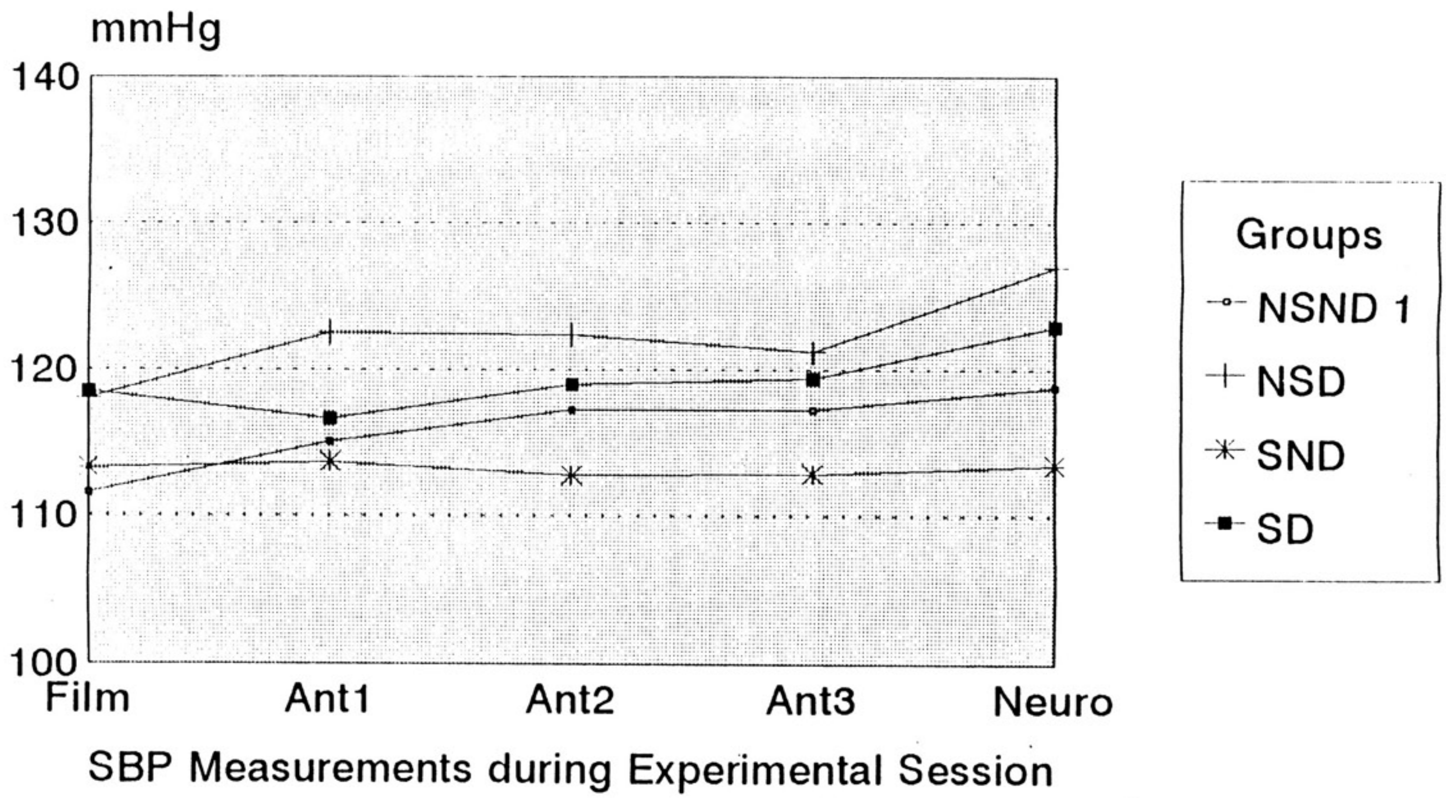
## DQ #3 - Uncomfortable Change Score (T2-T1)




stress X distraction interaction, $p<.04$

Figure Caption: **20:** Mean systolic blood pressure, represented over five measurements carried out during the film, the anticipatory stress/distraction period and the second set of neuropsychological tests for the four experimental groups. MANCOVA revealed a main effect of distraction, $\underline{p}<.05$.

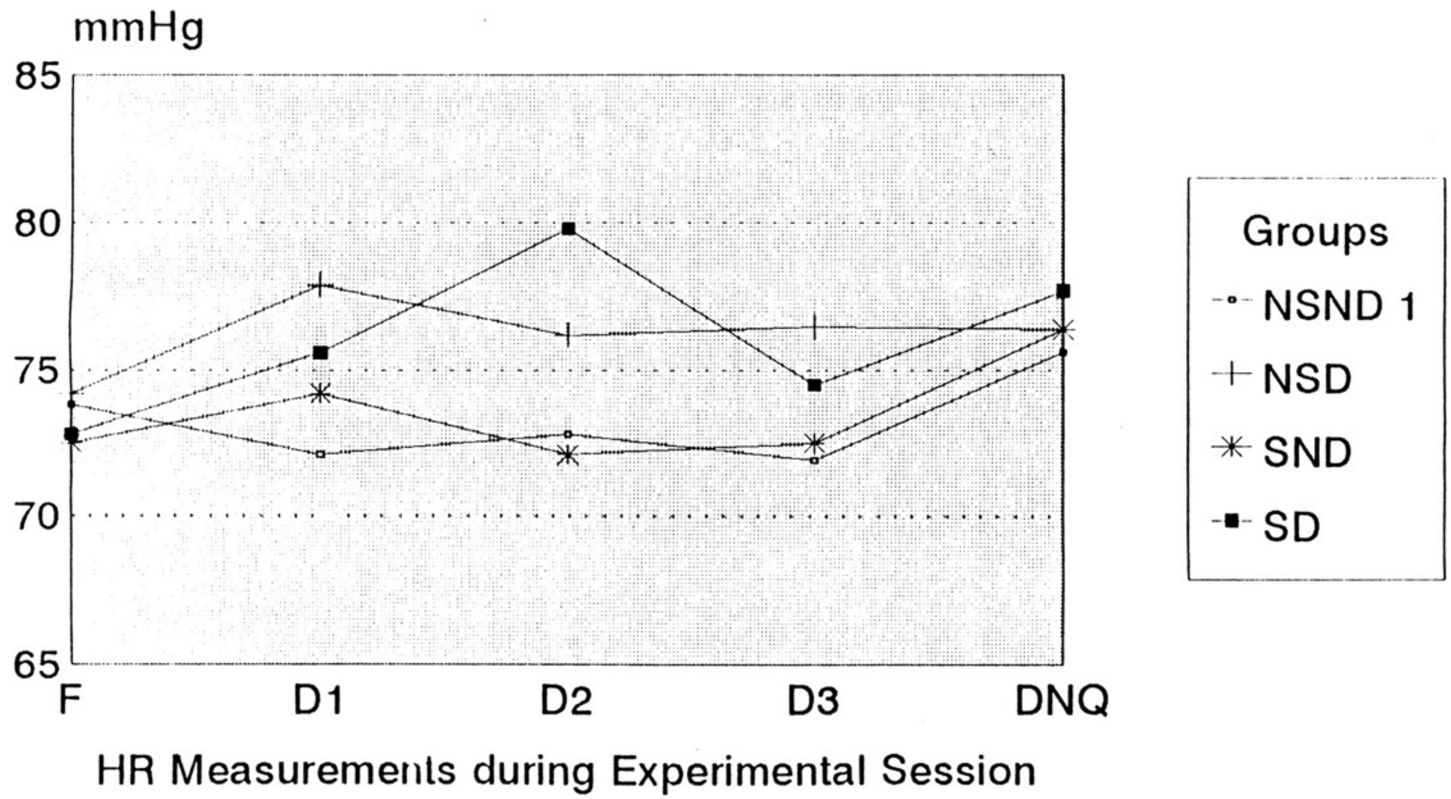
# Figure 20
## Systolic Blood Pressure




main effect of distraction, $p<.05$

Figure Caption: **21:** Mean heart rate (beats per minute), represented over five measurements carried out during the film, the anticipatory stress/distraction period and the second set of neuropsychological tests for the four experimental groups. MANCOVA revealed a main effect of distraction, $p<.05$.

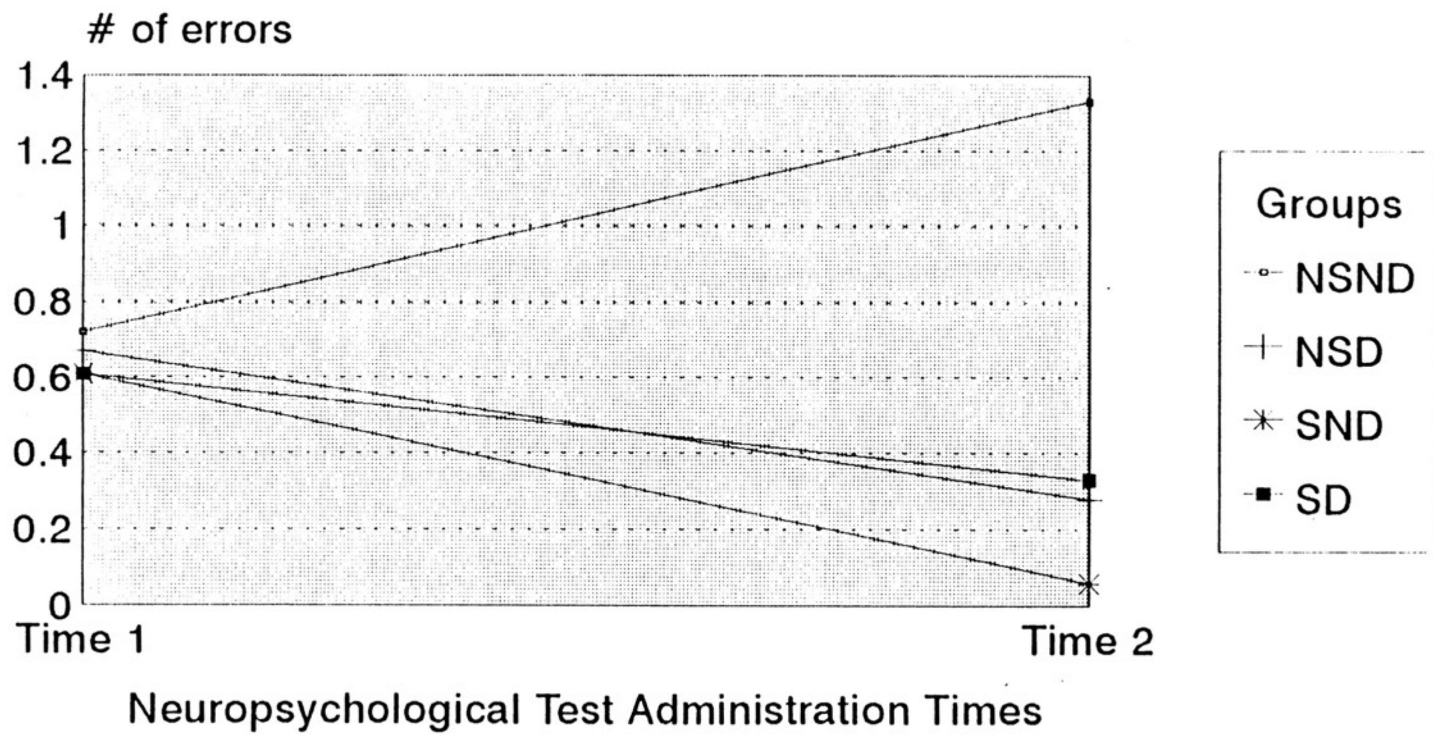
# Figure 21
## Heart Rate




main effect of distraction, $p < .05$

Figure Caption: **22:** Mean number of errors made on the Trails B test, represented over the two administrations for the four experimental groups. MANCOVA revealed a stress X distraction interaction, $\underline{p}<.04$. Tukey *post hocs* showed that the no stress-no distraction condition made significantly more errors than the two stress groups.

# Figure 22
## Trails B Errors
## Time 2




stress X distraction interaction, p<.04

## **Appendix A**

Neuropsychological Measures

Subject #_______

**Digit Span -- Form A**

| **Digits Forward** | | | | **Pass Fail** | **Score** |
|---|---|---|---|---|---|
| 1. | (3) | 5-8-2 | ________ | ________ | ____ |
| | | 6-9-4 | ________ | ________ | ____ |
| 2. | (4) | 6-4-3-9 | ________ | ________ | ____ |
| | | 7-2-8-6 | ________ | ________ | ____ |
| 3. | (5) | 4-2-7-3-1 | ________ | ________ | ____ |
| | | 7-5-8-3-6 | ________ | ________ | ____ |
| 4. | (6) | 6-1-9-4-7-3 | ________ | ________ | ____ |
| | | 3-9-2-4-8-7 | ________ | ________ | ____ |
| 5. | (7) | 5-9-1-7-4-2-8 | ________ | ________ | ____ |
| | | 4-1-7-9-3-8-6 | ________ | ________ | ____ |
| 6. | (8) | 5-8-1-9-2-6-4-7 | ________ | ________ | ____ |
| | | 3-8-2-9-5-1-7-4 | ________ | ________ | ____ |
| 7. | (9) | 2-7-5-8-6-2-5-8-4 | ________ | ________ | ____ |
| | | 7-1-3-9-4-2-5-6-8 | ________ | ________ | ____ |

Total Span Forward= _____ (max = 14)

Scale Score (AC)= _______

Subject #______

**Digit Span -- Form B**

| **Digits Forward** | | | | **Pass Fail** | **Score** |
|---|---|---|---|---|---|
| 1. | (3) | 3-6-4 | ______ | ______ | ____ |
| | | 4-9-7 | ______ | ______ | ____ |
| 2. | (4) | 2-7-5-6 | ______ | ______ | ____ |
| | | 3-5-1-8 | ______ | ______ | ____ |
| 3. | (5) | 6-9-2-7-4 | ______ | ______ | ____ |
| | | 1-3-8-6-2 | ______ | ______ | ____ |
| 4. | (6) | 2-9-5-8-4-1 | ______ | ______ | ____ |
| | | 7-3-4-8-2-5 | ______ | ______ | ____ |
| 5. | (7) | 5-3-7-4-2-8-9 | ______ | ______ | ____ |
| | | 2-8-3-1-5-7-6 | ______ | ______ | ____ |
| 6. | (8) | 2-4-1-7-9-8-6-5 | ______ | ______ | ____ |
| | | 9-6-8-5-7-3-4-2 | ______ | ______ | ____ |
| 7. | (9) | 1-3-2-6-9-4-8-5-7 | ______ | ______ | ____ |
| | | 3-9-5-1-4-6-9-2-8 | ______ | ______ | ____ |

Total Span Forward= _____ (max = 14)

Scale Score (AC)= _______

Subject #_______

**Digit Span -- Form A**

| **Digits Backward** | | | | **Pass Fail** | **Score** |
|---|---|---|---|---|---|
| 1. | (2) | 2-4 | ____ | ____ | ____ |
| | | 5-8 | ____ | ____ | ____ |
| 2. | (3) | 6-2-9 | ____ | ____ | ____ |
| | | 4-1-5 | ____ | ____ | ____ |
| 3. | (4) | 3-2-7-9 | ____ | ____ | ____ |
| | | 4-9-6-8 | ____ | ____ | ____ |
| 4. | (5) | 1-5-2-8-6 | ____ | ____ | ____ |
| | | 6-1-8-4-3 | ____ | ____ | ____ |
| 5. | (6) | 5-3-9-4-1-8 | ____ | ____ | ____ |
| | | 7-2-4-8-5-6 | ____ | ____ | ____ |
| 6. | (7) | 8-1-2-9-3-6-5 | ____ | ____ | ____ |
| | | 4-7-3-9-1-2-8 | ____ | ____ | ____ |
| 7. | (8) | 9-4-3-7-6-2-5-8 | ____ | ____ | ____ |
| | | 7-2-8-1-9-6-5-3 | ____ | ____ | ____ |

Total Span Forward= _____ (max = 14)

Scale Score (AC)= _______

Subject #_______

**Digit Span -- Form B**

| **Digits Backward** | | | | **Pass Fail** | **Score** |
|---|---|---|---|---|---|
| 1. | (2) | 6-3 | ______ | ______ | ____ |
| | | 4-9 | ______ | ______ | ____ |
| 2. | (3) | 5-7-1 | ______ | ______ | ____ |
| | | 9-2-8 | ______ | ______ | ____ |
| 3. | (4) | 3-7-4-5 | ______ | ______ | ____ |
| | | 8-6-4-2 | ______ | ______ | ____ |
| 4. | (5) | 6-5-3-9-2 | ______ | ______ | ____ |
| | | 7-1-4-5-8 | ______ | ______ | ____ |
| 5. | (6) | 2-6-9-1-5-3 | ______ | ______ | ____ |
| | | 8-2-7-3-4-5 | ______ | ______ | ____ |
| 6. | (7) | 6-3-1-8-4-7-2 | ______ | ______ | ____ |
| | | 1-5-2-8-6-9-4 | ______ | ______ | ____ |
| 7. | (8) | 4-1-8-3-9-7-5-6 | ______ | ______ | ____ |
| | | 9-6-3-5-2-7-1-8- | ______ | ______ | ____ |

Total Span Forward= _____ (max = 14)

Scale Score (AC)= _______

Subject #_______

**Visual Search Test**

"Now I will give you a sheet of paper with numbers all over it. I want you to draw a line through every 3 AND through every 8 (or through every 2 AND through every 5) that you see. Remember to look carefully at the whole sheet of paper. Draw a line through each 3 and 8 (or each 2 and each 5), but NOT through any other number. Do this as quickly as you can. Tell me when you are finished."

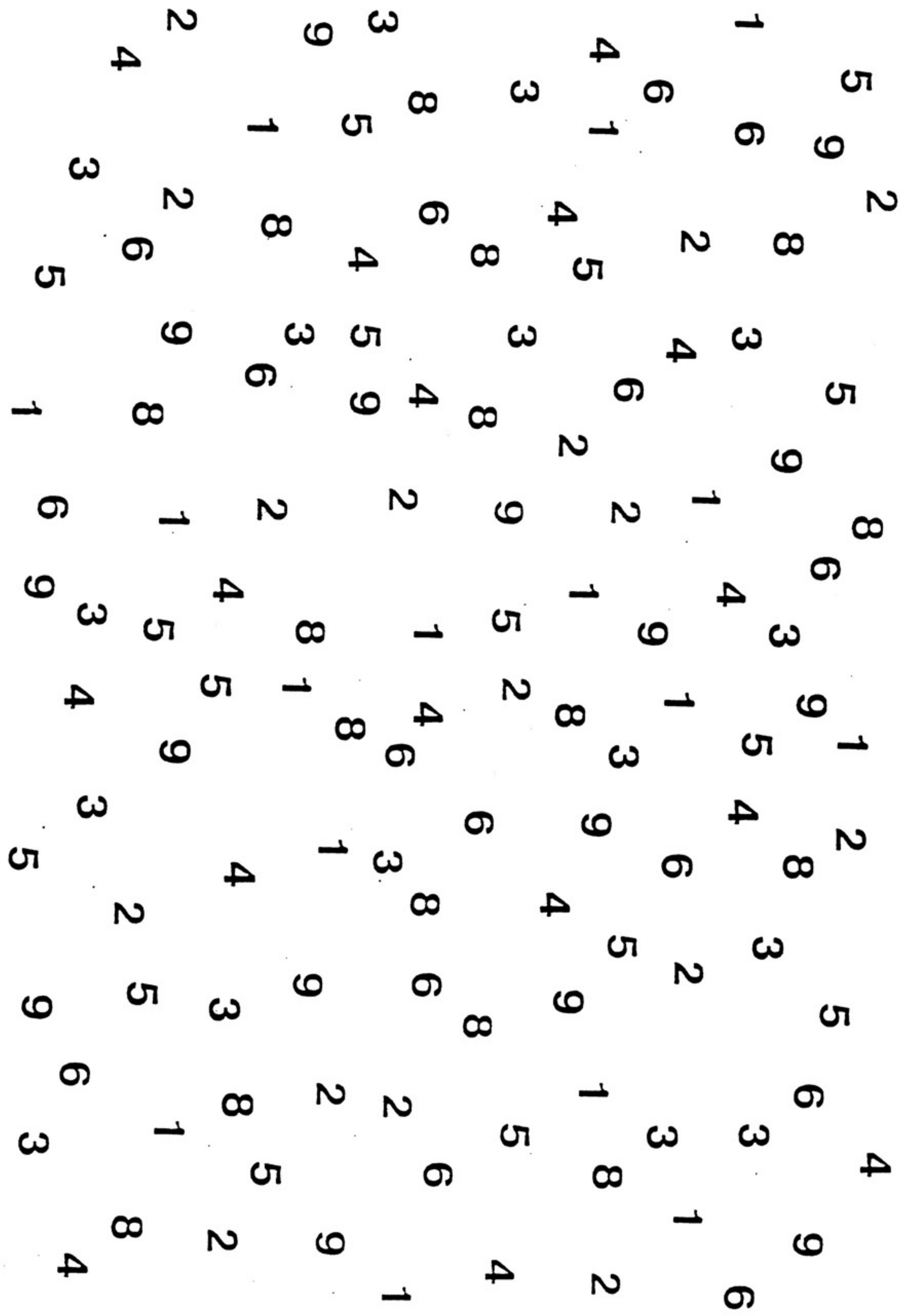
Begin timing when the sheet is placed in front of the subject. Stop timing when the subject indicates he/she is finished, OR after 180 seconds, whichever comes first.

**TRIAL #1**

| | HITS | COMMISSIONS | |
|---|---|---|---|
| Upper left | ____ | ____ | Total Time:_____secs. |
| Lower left | ____ | ____ | Time administered: |
| Upper right | ____ | ____ | |
| Lower right | ____ | ____ | |
| TOTAL | ____ | ____ | |

**TRIAL #**

| | HITS | COMMISSIONS | |
|---|---|---|---|
| Upper left | ____ | ____ | Total Time:_____secs. |
| Lower left | ____ | ____ | Time administered: |
| Upper right | ____ | ____ | |
| Lower right | ____ | ____ | |
| TOTAL | ____ | ____ | |



Subject #________

**Trail Making Test**

**Trial #1**

Part A: __________secs. __________errors

Part B: __________secs. __________errors

**Trial #2**

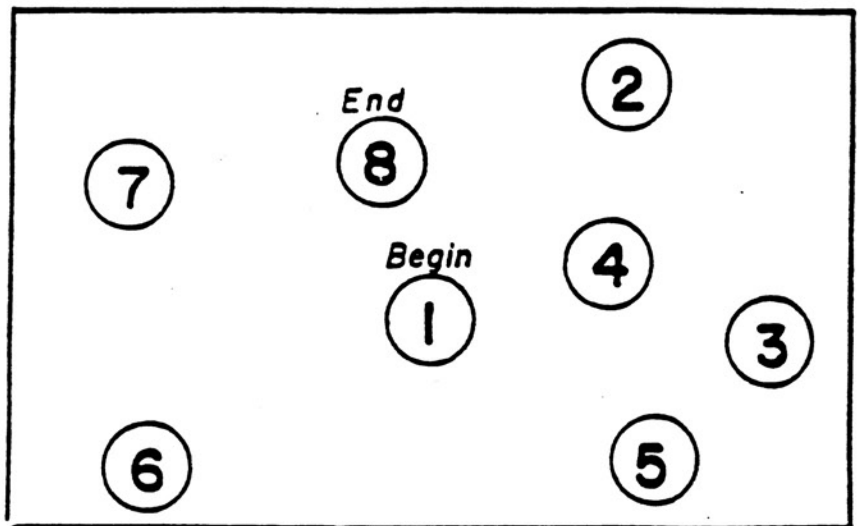
Part A: __________secs. __________errors

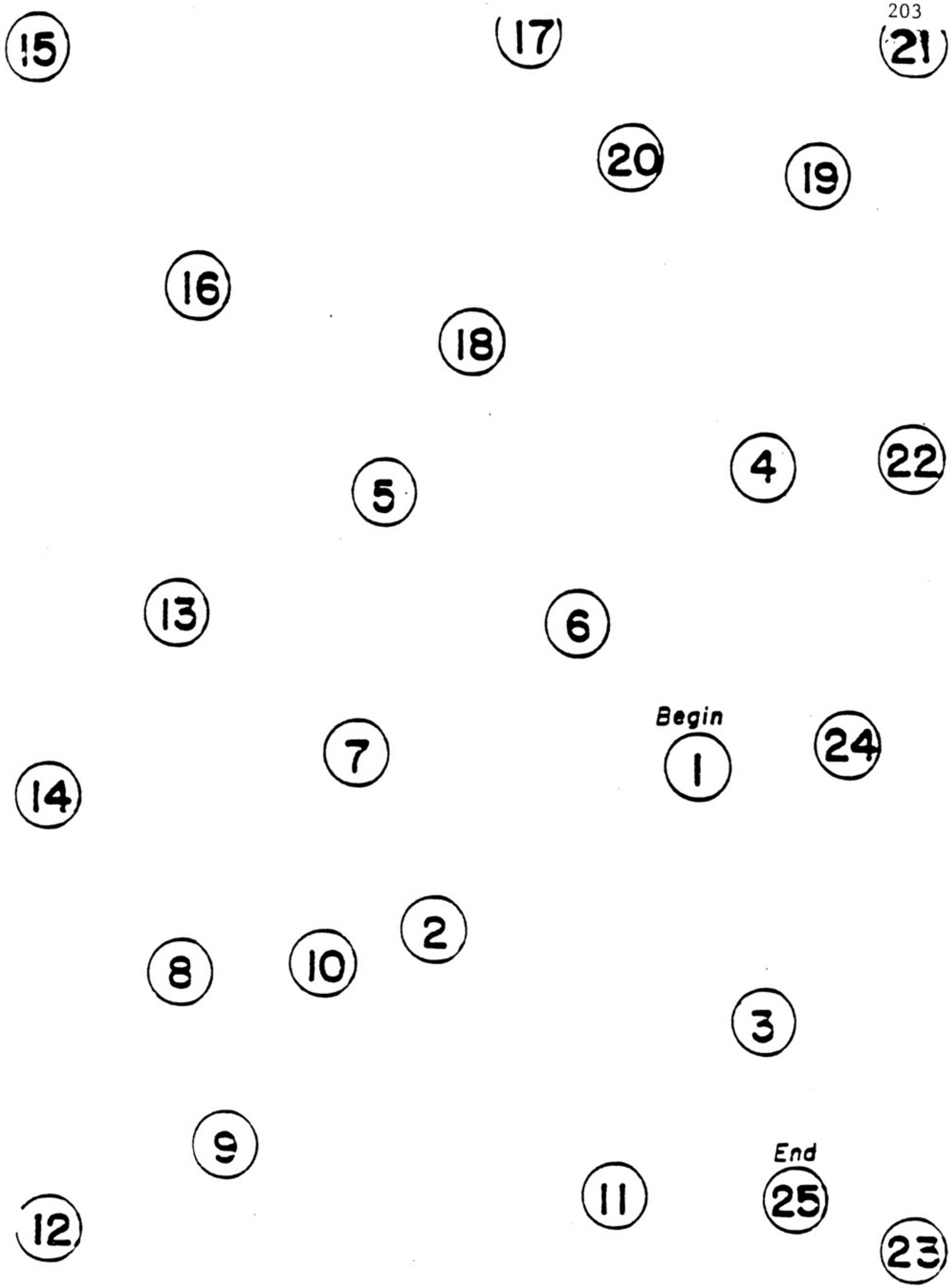
Part B: __________secs. __________errors

# TRAIL MAKING

## Part A

SAMPLE

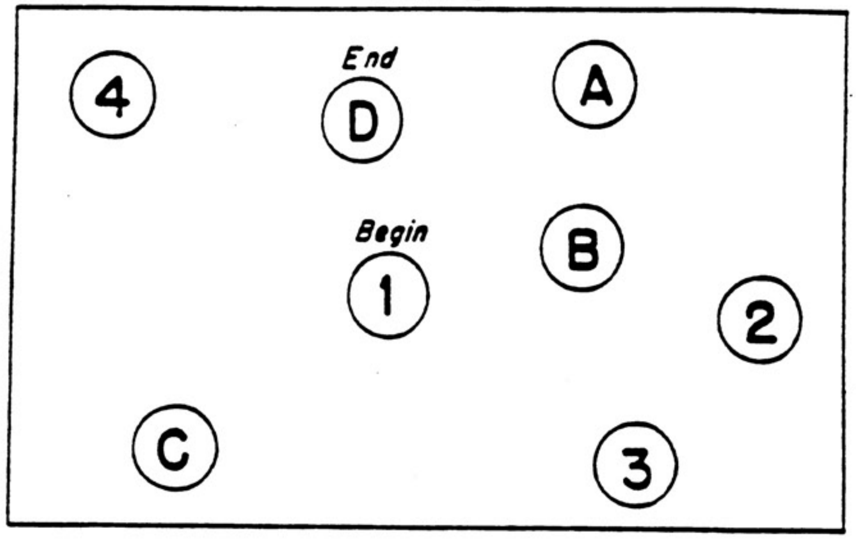


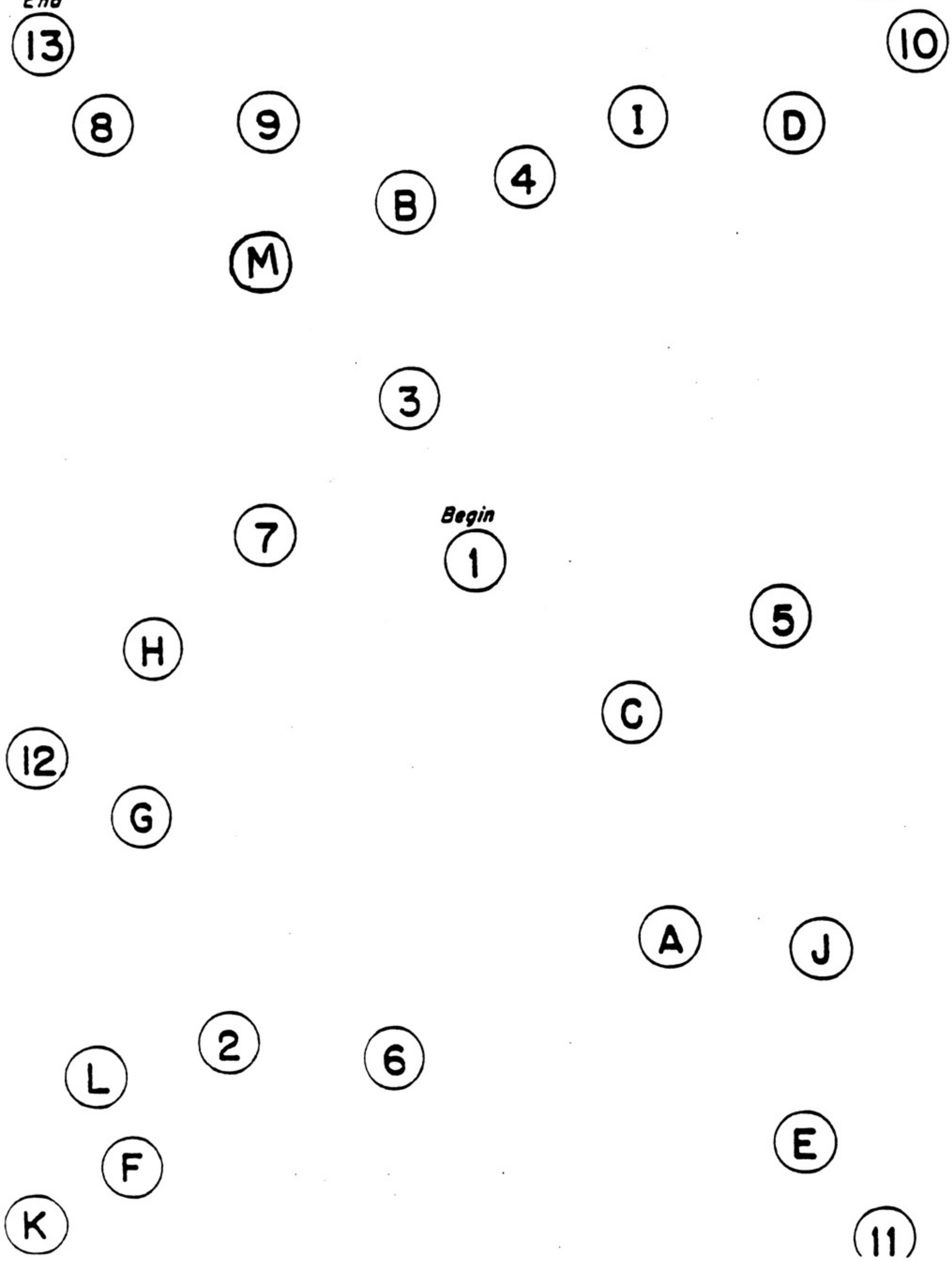

15
17
21
20
19
16
18
4
22
5
13
6
Begin
1
24
7
14
2
8
10
3
9
End
25
11
12
23

# TRAIL MAKING

## Part B

SAMPLE




End
13
10
8
9
I
D
4
B
M
3
7
Begin
1
5
H
C
12
G
A
J
2
6
L
E
F
K
11

Subject #_______

**Rey Auditory-Verbal Learning Test**

**Trial #1:**
"I am going to read a list of words. Listen carefully, for when I stop, you are to say back as many words as you can remember. It doesn't matter in what order you repeat them. Just try to remember as many as you can."

**Trial #2-5:**
"Now I'm going to read the same list again, and once again, when I stop I want you to tell as many words as you can remember, including words you said the first time. It doesn't matter in what order you say them. Just say as many words as you can remember whether or not you said them before."

**Trial B:**
"Now I'm going to read a second list of words. This time, again, you are to say back as many words of this second list as you can remember. Again, the order in which you say the words does not matter. Just try to remember as many as you can."

| | List A | List B | List C |
|---|---|---|---|
| (1) | Drum | Desk | Book |
| (2) | Curtain | Ranger | Flower |
| (3) | Bell | Bird | Train |
| (4) | Coffee | Shoe | Rug |
| (5) | School | Stove | Meadow |
| (6) | Parent | Mountain | Harp |
| (7) | Moon | Glasses | Salt |
| (8) | Garden | Towel | Finger |
| (9) | Hat | Cloud | Apple |
| (10) | Farmer | Boat | Chimney |
| (11) | Nose | Lamb | Button |
| (12) | Turkey | Gun | Log |
| (13) | Color | Pencil | Key |
| (14) | House | Church | Rattle |
| (15) | River | Fish | Gold |

Subject #________

Rey Auditory-Verbal Learning Test - Answer Sheet - Form A

| | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** | **Trial 5** |
|---|---|---|---|---|---|
| 1. Book | | | | | |
| 2. Flower | | | | | |
| 3. Train | | | | | |
| 4. Rug | | | | | |
| 5. Meadow | | | | | |
| 6. Harp | | | | | |
| 7. Salt | | | | | |
| 8. Finger | | | | | |
| 9. Apple | | | | | |
| 10. Chimney | | | | | |
| 11. Button | | | | | |
| 12. Log | | | | | |
| 13. Key | | | | | |
| 14. Rattle | | | | | |
| 15. Gold | | | | | |
| TOTAL | | | | | |

Subject #________

Rey Auditory-Verbal Learning Test - Answer Sheet

**Trial B**

1. Desk
2. Ranger
3. Bird
4. Shoe
5. Stove
6. Mountain
7. Glasses
8. Towel
9. Cloud
10. Boat
11. Lamb
12. Gun
13. Pencil
14. Church
15. Fish

TOTAL

Subject #________

Rey Auditory-Verbal Learning Test - Answer Sheet - Form B

| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 |
|---|---|---|---|---|---|
| 1. Drum | | | | | |
| 2. Curtain | | | | | |
| 3. Bell | | | | | |
| 4. Coffee | | | | | |
| 5. School | | | | | |
| 6. Parent | | | | | |
| 7. Moon | | | | | |
| 8. Garden | | | | | |
| 9. Hat | | | | | |
| 10. Farmer | | | | | |
| 11. Nose | | | | | |
| 12. Turkey | | | | | |
| 13. Color | | | | | |
| 14. House | | | | | |
| 15. River | | | | | |
| TOTAL | | | | | |

Subject #________

Rey Auditory-Verbal Learning Test - Answer Sheet

**Trial B**

1. Desk
2. Ranger
3. Bird
4. Shoe
5. Stove
6. Mountain
7. Glasses
8. Towel
9. Cloud
10. Boat
11. Lamb
12. Gun
13. Pencil
14. Church
15. Fish

TOTAL

# Appendix B

## Self-Report Measures

Subject #________

**Background Questionnaire**

1. Age:__________ 2. Date of birth:____/____/____

3. Race:
   _____White
   _____Black
   _____Hispanic
   _____Asian
   _____Native American
   _____Other

4. Marital Status:
   _____Single
   _____Living with partner
   _____Married
   _____Separated
   _____Divorced
   _____Widowed

5. Do you have any children? _____yes _____no
   a. If yes, how many? _____

6. Education:
   _____Completed grammar school or less
   _____Some high school
   _____Completed high school
   _____Some college/trade school
   _____Completed college/trade school
   _____Some post-graduate work
   _____Completed graduate work (Degree held:_____)

7. Your occupation:______________ 8. Spouse's Occupation__________ (if applicable)

9. Employment:

| YOU | | SPOUSE (if applicable) |
|---|---|---|
| ___ | Employed full-time | ___ |
| ___ | Employed part-time | ___ |
| ___ | Unemployed | ___ |
| ___ | Laid Off | ___ |

10. Your preferred hand:
    _____Right
    _____Left
    _____Ambidextrous (both hands)

NAME ____________ DATE ________

SEX Male M Female F

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

| Item | Not at all | A little | Moderately | Quite a bit | Extremely |
|---|---|---|---|---|---|
| 1. Friendly | 0 | 1 | 2 | 3 | 4 |
| 2. Tense | 0 | 1 | 2 | 3 | 4 |
| 3. Angry | 0 | 1 | 2 | 3 | 4 |
| 4. Worn out | 0 | 1 | 2 | 3 | 4 |
| 5. Unhappy | 0 | 1 | 2 | 3 | 4 |
| 6. Clear-headed | 0 | 1 | 2 | 3 | 4 |
| 7. Lively | 0 | 1 | 2 | 3 | 4 |
| 8. Confused | 0 | 1 | 2 | 3 | 4 |
| 9. Sorry for things done | 0 | 1 | 2 | 3 | 4 |
| 10. Shaky | 0 | 1 | 2 | 3 | 4 |
| 11. Listless | 0 | 1 | 2 | 3 | 4 |
| 12. Peeved | 0 | 1 | 2 | 3 | 4 |
| 13. Considerate | 0 | 1 | 2 | 3 | 4 |
| 14. Sad | 0 | 1 | 2 | 3 | 4 |
| 15. Active | 0 | 1 | 2 | 3 | 4 |
| 16. On edge | 0 | 1 | 2 | 3 | 4 |
| 17. Grouchy | 0 | 1 | 2 | 3 | 4 |
| 18. Blue | 0 | 1 | 2 | 3 | 4 |
| 19. E[illegible] | | | | | |
| 21. Hopeless | 0 | 1 | 2 | 3 | 4 |
| 22. Relaxed | 0 | 1 | 2 | 3 | 4 |
| 23. Unworthy | 0 | 1 | 2 | 3 | 4 |
| 24. Spiteful | 0 | 1 | 2 | 3 | 4 |
| 25. Sympathetic | 0 | 1 | 2 | 3 | 4 |
| 26. Uneasy | 0 | 1 | 2 | 3 | 4 |
| 27. Restless | 0 | 1 | 2 | 3 | 4 |
| 28. Unable to concentrate | 0 | 1 | 2 | 3 | 4 |
| 29. Fatigued | 0 | 1 | 2 | 3 | 4 |
| 30. Helpful | 0 | 1 | 2 | 3 | 4 |
| 31. Annoyed | 0 | 1 | 2 | 3 | 4 |
| 32. Discouraged | 0 | 1 | 2 | 3 | 4 |
| 33. Resentful | 0 | 1 | 2 | 3 | 4 |
| 34. Nervous | 0 | 1 | 2 | 3 | 4 |
| 35. Lonely | 0 | 1 | 2 | 3 | 4 |
| 36. Miserable | 0 | 1 | 2 | 3 | 4 |
| 37. Muddled | 0 | 1 | 2 | 3 | 4 |
| 38. Cheerful | 0 | 1 | 2 | 3 | 4 |
| 39. Bitter | 0 | 1 | 2 | 3 | 4 |
| 40. Exhausted | 0 | 1 | 2 | 3 | 4 |
| 41. Anxious | 0 | 1 | 2 | 3 | 4 |
| 42. Ready to fight | | | | | 4 |
| 45. Desperate | 0 | 1 | 2 | 3 | 4 |
| 46. Sluggish | 0 | 1 | 2 | 3 | 4 |
| 47. Rebellious | 0 | 1 | 2 | 3 | 4 |
| 48. Helpless | 0 | 1 | 2 | 3 | 4 |
| 49. Weary | 0 | 1 | 2 | 3 | 4 |
| 50. Bewildered | 0 | 1 | 2 | 3 | 4 |
| 51. Alert | 0 | 1 | 2 | 3 | 4 |
| 52. Deceived | 0 | 1 | 2 | 3 | 4 |
| 53. Furious | 0 | 1 | 2 | 3 | 4 |
| 54. Efficient | 0 | 1 | 2 | 3 | 4 |
| 55. Trusting | 0 | 1 | 2 | 3 | 4 |
| 56. Full of pep | 0 | 1 | 2 | 3 | 4 |
| 57. Bad-tempered | 0 | 1 | 2 | 3 | 4 |
| 58. Worthless | 0 | 1 | 2 | 3 | 4 |
| 59. Forgetful | 0 | 1 | 2 | 3 | 4 |
| 60. Carefree | 0 | 1 | 2 | 3 | 4 |
| 61. Terrified | 0 | 1 | 2 | 3 | 4 |
| 62. Guilty | 0 | 1 | 2 | 3 | 4 |
| 63. Vigorous | 0 | 1 | 2 | 3 | 4 |
| 64. Uncertain about things | 0 | 1 | 2 | 3 | 4 |
| 65. Bushed | 0 | 1 | 2 | 3 | 4 |

MAKE SURE YOU HAVE ANSWERED EVERY ITEM

INSTRUCTIONS FOR SCORING YOUR ADJUSTMENT TO
TO YOUR RECENT LIFE CHANGE

Persons adapt to their recent life changes in different ways. Some people find the adjustment to a residential move, for example, to be enormous, while others find very little life adjustment necessary. You are now requested to "score" each of the recent life changes that you marked with an "X" as to the amount of adjustment you needed to handle the event.

Your scores can range from 1 to 100 "points." If, for example, you experienced a recent residential move but felt it required very little life adjustment, you would choose a low number and place it in the blank to the right of the question's boxes. On the other hand, if you recently changed residence and felt it required a near maximal life adjustment, you would place a high number, toward 100, in the blank to the right of that question's boxes. For intermediate life adjustment scores you would choose intermediatge numbers between 1 and 100.

Please go back through your questionnaire and for each recent life change you indicated with an "X," choose your personal life change adjustment score (between 1 and 100) which reflects what you saw to be the amount oflife adjustment necessary to cope with or handle the event. Use both your estimates of the intensity of the life change and its duration to arrive at your scores.

# RECENT LIFE CHANGES QUESTIONNAIRE

## I. Instructions for Marking Your Recent Life Changes

To answer the questions below, mark an "x" in one or more of the columns to the right of each question. If the event in question has occurred to you within the past two years, indicate when it occurred by marking the appropriate column: 0-6 months ago, 7-12 months ago, etc. It may be the case with some of the events below that you experienced them over more than one of the time periods listed for the past two years. If so, mark all the appropriate columns. If the event has not occurred to you during the last two years (or has never occurred to you) leave all the columns empty.

Now go through the questionnaire and mark your recent life changes. The column marked "Your Adjustment Score" will be explained at the end of the questionnaire.

### A. HEALTH

| | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| within the time periods listed, have you experienced: | | | | | |
| 1. an illness or injury which: (a) kept you in bed a week or more, or took you to the hospital? | ____ | ____ | ____ | ____ | ______ |
| (b) was less serious than described above? | ____ | ____ | ____ | ____ | ______ |
| 2. a major change in eating habits? | ____ | ____ | ____ | ____ | ______ |
| 3. a major change in sleeping habits? | ____ | ____ | ____ | ____ | ______ |
| 4. a change in your usual type and/or amount of recreation? | ____ | ____ | ____ | ____ | ______ |
| 5. major dental work? | ____ | ____ | ____ | ____ | ______ |

### B. WORK

| | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| 6. changed to a new type of work? | ____ | ____ | ____ | ____ | ______ |
| 7. changed your work hours or conditions? | ____ | ____ | ____ | ____ | ______ |

B. WORK

| within the time periods listed, have you: | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| 8. had a change in your responsibilities at work? | | | | | |
| (a) more responsibilities? | ____ | ____ | ____ | ____ | ________ |
| (b) less responsibilities? | ____ | ____ | ____ | ____ | ________ |
| (c) promotion? | ____ | ____ | ____ | ____ | ________ |
| (d) demotion? | ____ | ____ | ____ | ____ | ________ |
| (e) transfer? | ____ | ____ | ____ | ____ | ________ |
| 9. experienced troubles at work? | ____ | ____ | ____ | ____ | ________ |
| 10. experienced a major business readjustment? | ____ | ____ | ____ | ____ | ________ |
| 11. retired? | ____ | ____ | ____ | ____ | ________ |
| experienced being: | | | | | |
| (a) fired from work? | ____ | ____ | ____ | ____ | ________ |
| (b) laid off from work? | ____ | ____ | ____ | ____ | ________ |
| 13. taken courses by mail or studied at home to help you in your work? | ____ | ____ | ____ | ____ | ________ |

C. HOME AND FAMILY

| within the time periods listed, have you experienced: | | | | | |
|---|---|---|---|---|---|
| 14. a change in residence: | | | | | |
| (a) a move within the same town or city? | ____ | ____ | ____ | ____ | ________ |
| (b) a move to a different town, city, or state? | ____ | ____ | ____ | ____ | ________ |
| 15. a change in family "get-togethers"? | ____ | ____ | ____ | ____ | ________ |
| a major change in the health or behavior of a family member (illnesses, accidents, drug or disciplinary problems, etc.)? | ____ | ____ | ____ | ____ | ________ |

| within the time periods listed, have you experienced: | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| 18. the death of a spouse? | ______ | ______ | ______ | ______ | ________ |
| 19. the death of a: | | | | | |
| (a) child? | ______ | ______ | ______ | ______ | ________ |
| (b) brother or sister? | ______ | ______ | ______ | ______ | ________ |
| (c) parent? | ______ | ______ | ______ | ______ | ________ |
| (d) other close family member? | ______ | ______ | ______ | ______ | ________ |
| 20. the death of a close friend? | ______ | ______ | ______ | ______ | ________ |
| 21. a change in the marital status of your parents: | | | | | |
| (a) divorce? | ______ | ______ | ______ | ______ | ________ |
| (b) remarriage? | ______ | ______ | ______ | ______ | ________ |

NOTE:
(Questions 22-33 concern marriage. For persons never marrried, go to item 34.)

| | | | | | |
|---|---|---|---|---|---|
| marriage? | ______ | ______ | ______ | ______ | ________ |
| 23. a change in arguments with your spouse? | ______ | ______ | ______ | ______ | ________ |
| 24. in-law problems? | ______ | ______ | ______ | ______ | ________ |
| 25. a separation from spouse: | | | | | |
| (a) due to work? | ______ | ______ | ______ | ______ | ________ |
| (b) due to marital problems? | ______ | ______ | ______ | ______ | ________ |
| 26. a reconciliation with spouse? | ______ | ______ | ______ | ______ | ________ |
| 27. a divorce? | ______ | ______ | ______ | ______ | ________ |
| 28. a gain of a new family member: | | | | | |
| (a) birth of a child? | ______ | ______ | ______ | ______ | ________ |
| (b) adoption of a child? | ______ | ______ | ______ | ______ | ________ |
| (c) a relative moving in with you? | ______ | ______ | ______ | ______ | ________ |
| 29. spouse beginning or ceasing work outside the home? | ______ | ______ | ______ | ______ | ________ |

| within the time periods listed, have you experienced: | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Scrore |
|---|---|---|---|---|---|
| 30. wife (or self) becoming pregnant? | ______ | ______ | ______ | ______ | ________ |
| 31. a child leaving home: | | | | | |
| (a) due to marriage? | ______ | ______ | ______ | ______ | ________ |
| (b) to attend college? | ______ | ______ | ______ | ______ | ________ |
| (c) for other reasons? | ______ | ______ | ______ | ______ | ________ |
| 32. wife or (self) having a miscarriage or an abortion? | ______ | ______ | ______ | ______ | ________ |
| 33. birth of a grandchild? | ______ | ______ | ______ | ______ | ________ |

D. PERSONAL AND SOCIAL

| within the time periods listed, have you experienced: | | | | | |
|---|---|---|---|---|---|
| a major personal achievement? | ______ | ______ | ______ | ______ | ________ |
| 35. a change in your personal habits (your dress, friends life-style, etc.)? | ______ | ______ | ______ | ______ | ________ |
| 36. sexual difficulties? | ______ | ______ | ______ | ______ | ________ |
| 37. beginning or ceasing school or college? | ______ | ______ | ______ | ______ | ________ |
| 38. a change of school or college? | ______ | ______ | ______ | ______ | ________ |
| 39. a vacation? | ______ | ______ | ______ | ______ | ________ |
| 40. a change in your religious beliefs? | ______ | ______ | ______ | ______ | ________ |
| 41. a change in your social activities (clubs, movies, visiting)? | ______ | ______ | ______ | ______ | ________ |
| a minor violation of the law? | ______ | ______ | ______ | ______ | ________ |

within the time periods listed, have you experienced:

| | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| 43. legal troubles resulting in your being held in jail? | ____ | ____ | ____ | ____ | ________ |
| 44. a change in your political beliefs? | ____ | ____ | ____ | ____ | ________ |
| 45. a new, close, personal relationship? | ____ | ____ | ____ | ____ | ________ |
| 46. an engagement to marry? | ____ | ____ | ____ | ____ | ________ |
| 47. a "falling out" of a close personal relationship? | ____ | ____ | ____ | ____ | ________ |
| 48. girlfriend (or boyfriend) problems? | ____ | ____ | ____ | ____ | ________ |
| 49. a loss or damage of personal property? | ____ | ____ | ____ | ____ | ________ |
| an accident? | ____ | ____ | ____ | ____ | ________ |
| 51. a major decision regarding your immediate future? | ____ | ____ | ____ | ____ | ________ |

E. FINANCIAL

within the time periods listed, have you:

| | 19-24 mo. ago | 13-18 mo. ago | 7-12 mo. ago | 0-6 mo. ago | Your Adjustment Score |
|---|---|---|---|---|---|
| 52. taken on a moderate purchase, such as a T.V., car, freezer? | ____ | ____ | ____ | ____ | ________ |
| 53. taken on a major purchase or a mortgage loan, such as a home, business, property? | ____ | ____ | ____ | ____ | ________ |
| 54. experienced a foreclosure on a mortgage or loan? | ____ | ____ | ____ | ____ | ________ |
| 55. experienced a major change in finances: | | | | | |
| (a) increased income? | ____ | ____ | ____ | ____ | ________ |
| (b) decreased income? | ____ | ____ | ____ | ____ | ________ |
| (c) credit rating difficulties? | ____ | ____ | ____ | ____ | ________ |

**The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate <u>how often</u> you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.**

1. In the last month, how often have you been upset because of something that happened unexpectedly?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

2. In the last month, how often have you felt that you were unable to control the important things in your life?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

3. In the last month, how often have you felt nervous and "stressed"?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

4. In the last month, how often have you dealt successfully with irritating life hassles?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

5. In the last month, how often have you felt that you were effectively coping with important changes that were occuring in your life?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

6. In the last month, how often have you felt confident about your ability to handle your personal problems?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

7. In the last month, how often have you felt that things were going your way?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

8. In the last month, how often have you found that you could not cope with all the things that you had to do?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

9. In the last month, how often have you been able to control irritations in your life?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

10. In the last month, how often have you felt that you were on top of things?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

11. In the last month, how often have you been angered because of things that happened that were outside of your control?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

12. In the last month, how often have you found yourself thinking about things that you have to accomplish?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

13. In the last month, how often have you been able to control the way you spend your time?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

# Distraction Questionnaire

Please circle the number of the response which most fits your answers to the questions below.

1. How much are you thinking about the next film you will be seeing?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all | | | | | | extensively |

2. How stressed did you feel in the past 15 minutes?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all stressed | | | | | | extremely stressed |

3. How uncomfortable do you feel right now?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all | | | | | | extremely uncomfortable |

4. How enjoyable did you find the film you just saw?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all | | | | | | extremely enjoyable |

5. How distracted did you feel in the past 15 minutes?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all | | | | | | extremely distracted |

6. How interested were you in the film you just saw?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all | | | | | | extremely interested |

7. How stressful do you think the film you are about to see will

be?

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| not at all | | | | | | extremely stressful |

8. How much did you pay attention to the film you just watched?

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| not at all | | | | | | extremely attentive |

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